

# **Interviews with Prof. David Bohm**



**Prof. David Bohm**

**Collected & Compiled : Symmetry Seeker**



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# Interview Session - 1

## Wilkins:

One thing is to try to go back to one's early childhood and see, for example, to what extent the experience is there. Or interact, including interactions with one's parents and other things at that time may have set one in a certain direction of intellectual development. When I tried to do this in my own case I couldn't find very much but I had one or two early memories of seeing sailors taking to pieces a field gun on display and putting all the parts together again and firing the gun in about one minute or something incredible. So this idea of disassembly and assembly made a big impression on me. But so far as my parents were concerned, all I know is that I was very fortunate in that my father was always encouraging about books and any sort of general interest in things. So in that respect I was if anything over-supplied with encouragements, but this did not, as it may sometimes in young people today, turn me away in other directions. I think it tended to encourage me. Are there any other sorts of

things you would like to say to —? Do you think that your early childhood or your parent's might have encouraged you to go in a certain direction by either consciously being encouraging or possibly lack of interest or opposition, or how would it be?

**Bohm:**

Well, I can't say that they encouraged me at all in the direction of science. If we consider first my father, then my mother, and possibly the family as a whole, my father was very much down to earth. As a businessman he emphasized common sense and being practical and making money and making your place in society.

**Wilkins:**

Well, the scientist is also very down to earth.

**Bohm:**

But I'm saying that in that sense there was some positive and some negative. In his down to earth emphasis and common sense I think that affected me so that I constantly wanted to bring things out in a more common language rather than in an abstruse language. So I think that had a positive effect. On



the other hand his constant emphasis on the importance of other people's opinions — you know, fitting into society — he took the view essentially that whatever society in which you live said was right was right; that essentially what people thought, people in general, was right. I think I rebelled against that. I couldn't accept that.

**Wilkins:**

Didn't you like these other people?

**Bohm:**

No, it wasn't that I didn't dislike them, I just felt that merely because people were saying things didn't make it true and that it was quite possible for everybody to agree on something that was false, and he seemed to be saying that if everybody agreed on it, it couldn't be false. I don't think he really would have said that 100 percent but it was a tendency in his thought. I'll come back to that later and possibly begin to see it going wrong. Now, I think it's hard to say from my mother what I got because she was not interested in intellectual things at all. But people say that matter and mother have the same root and matrix and so on. Mother tends to emphasize the

more material side of things, to emphasize the body, the earth and so on rather than the sky or the spirit. And probably I got some tendency towards looking at matter as fundamental in a way which was nonverbal in a sense I can't really trace. There wasn't enough background, anything very favorable to science on the whole. I mean, I was interested, of course, and people used to say electricity is mysterious, nobody can see it which must have aroused my interest.

**Wilkins:**

If I can just interrupt a second. Going back to these things about father and mother. I mean, your father to some extent was putting some kind of pressure on you to encourage you to become a conventional businessman.

**Bohm:**

Yes, and to fit into society and to become socially successful. Not only in business, but as an entertaining person all around in society.

**Wilkins:**

Oh yes, I see. Socially approved. You mean he was quite sociable and successful?

**Bohm:**

He was very good socially and people liked to hear him talk. He could talk to anybody and they enjoyed it.

**Wilkins:**

Yes, so that he easily fitted into society and conventional ideas and he interacted well socially.

**Bohm:**

Yes. Now, he told me something later once which was very revealing. You see he said he had once as a young man been interested in socialism. Very young — he had just come from Europe you see. And he talked to some working men about socialism and they made fun of him, and as a Jew you have nothing to say about socialism. You have nothing to do with socialism. You've got to make money. Jew's, you know, there is an absolute gulf between being a Jew and being a working man. You see

that's part of the background. We lived — my father's store was in a working class district, Polish and Irish.

**Wilkins:**

And the store sold what?

**Bohm:**

Furniture.

**Wilkins:**

Furniture, yes.

**Bohm:**

Now he was very good with these people. He could talk Polish, Lithuanian, all sorts of languages that they talked in, and he could bargain with them which they enjoyed. In fact, half the reason they came to such a store was they could bargain whereas in the big stores down town they couldn't do that.

**Wilkins:**

You mean he made a creative social interaction with the bargaining process?

**Bohm:**

Yes

**Wilkins:**

It interested them. It wasn't just a matter of cheap furniture. He made it an interesting experience.

**Bohm:**

They could say they succeeded in outwitting the Jew and so on, you see, and it gave them pleasure.

**Wilkins:**

And so probably he was really outwitting them.

**Bohm:**

Yea, but they got plenty out of outwitting him. So he arranged it that way, so he was quite good probably.

**Wilkins:**

So this was a kind of creative intellectual game, to some extent, that he was playing. So presumably he was a man of some intelligence.

**Bohm:**

Yes, I think he was very intelligent. My mother was also very intelligent, but there were some problems with her. She wasn't really happy.

**Wilkins:**

Or did she find it difficult that your father was very good at social graces and she was very bad?

**Bohm:**

She was very bad. In fact my father, that was one of his principal complaints, that she didn't help him. He pictured the wife should really arrange, should be a tremendous help to the husband in society and she was zero help.

**Wilkins:**

Yes, in fact he probably made it much worse projecting all these expectations on to her and everything. And she probably retreated under the burden.

**Bohm:**

Yes.

**Wilkins:**

So the father was this — I suppose you might to some extent say that, just as you have been searching for unified theories of matter in the universe and so on, your father in fact was engaged in a sort of unified process of socialization with all these people and everything.

**Bohm:**

He felt there was a certain circle in which he wanted to be united, especially the circle of his friends who were Jewish businessmen. He would play cards with them and talk with them.

**Wilkins:**

And he was really quite sort of vigorous in all these activities, wasn't he?

**Bohm:**

Yes, he enjoyed it.

**Wilkins:**

Very lively.

**Bohm:**

Yes, very lively.

**Wilkins:**

He put a lot of energy into it.

**Bohm:**

That's right. And he said people said he was a good talker, entertaining, except at home where it was very unentertaining. It was always angry.



**Wilkins:**

Yea, because you mean he was fed up with his wife.

**Bohm:**

Yes.

**Wilkins:**

Hoping she would back him up

**Bohm:**

Yes.

**Wilkins:**

I wonder if it's a reasonable comparison to make that he was putting all his energy into sort of this unifying activity, this social business life, and then you put all this energy into unifying notions of scientific ideas.

**Bohm:**

Well, it's hard to know. He felt?

**Wilkins:**

You've got the common feature: each a lot of energy going into both of these processes one generation removed.

**Bohm:**

Yes, but I would have liked to have seen a unified social life, but I felt that it didn't exist, that it was rather a fake, you see. I couldn't put it in words at the time, but I wasn't impressed by any of what he was doing and I felt something false about it.

**Wilkins:**

Yes, and you doubtless were a bit disappointed in him.

**Bohm:**

And he was very disappointed in me.

**Wilkins:**

Yes, and he would say he was disappointed in you because you didn't conform to this and back him up.

**Bohm:**

Yes, and he wanted me to be a practical businessperson and so on. You see, the problem with all the different classes and religions was that most of the boys that I knew were, you know, poor people, working class, and largely Polish and Irish in decent. The Jews were really — there were only two or three. We were the only Jewish family for a mile I would say, or half a mile.

**Wilkins:**

You were really a minority then.

**Bohm:**

Yes. Where I went to school I don't know if there were any other Jewish people in the class. There may have been one occasionally. So I didn't feel identified with the Jews, you see. I felt I wanted to be identified with the larger society, American, or sometimes I'd see people?

**Wilkins:**

Because of your own social contacts.

**Bohm:**

Yes, that's right. When I was about four-years-old or thereabouts I was asked if I was Jewish, and I said no, I'm English. Obviously I didn't know anything about England; I meant the language was the meaningful thing to me. I identified the culture with the language.

**Wilkins:**

Was your father a practicing Jew?

**Bohm:**

Yes, yes. Not very devout, but he was practicing. My grandfather was far more so.

**Wilkins:**

Was your grandfather in the United States as well?

**Bohm:**

No, he immigrated, you see, and he was there when my father arrived. My father left Europe when he was about 15 years old. He came by himself to America. The practice was he was told of the name

of a Jewish family to go to where they would help him, you see.

**Wilkins:**

But your grandfather was there already.

**Bohm:**

Right. He had arrived a number of years before that, long before. He had already set up a business by the time my father arrived.

**Wilkins:**

Why didn't your father join his father?

**Bohm:**

My father's father and mother died in the plague when he was about twelve years old and he was then shunted around from family to family as was the custom.

**Wilkins:**

Your father?

**Bohm:**

Yes, my father became an orphan you see.

**Wilkins:**

But I thought you said his father had been in America.

**Bohm:**

No, that's my grandfather, my mother's father.

**Wilkins:**

Oh. Your mother's father had been there but your father's father?

**Bohm:**

Had died.

## **Wilkins:**

Lost his parents.

## **Bohm:**

He had lost his parents and he'd been shunted around from one family to another. He'd been gone to what is called the Yehiva, which was the study of religious studies. And at fifteen he immigrated to America and changed his name in order to avoid military service. Then he was directed to my grandfather by somebody. My grandfather already had a small business in furniture. As was the custom, he was supposed to marry, or it was hoped he would marry the daughter of the house, which he did. There were several children there but he married one of them. He got a dowry of \$5,000.00 with which he set up his business, too, the furniture business. In those days it was a fair amount of money. My grandfather was also very good at bargaining and talking all the languages and making the rounds.

**Wilkins:**

Your mother's father?

**Bohm:**

Yes, making friends with all the Polish people and so on. Not personal friends but sort of be friendly with them in the store and drink a bit of Schnapps with them. He also had a friend, another non-Jewish friend, called Horst, from Czechoslovakia, in a big furniture store. He managed to buy up all the rejects through Horst.

**Wilkins:**

Your father?

**Bohm:**

My grandfather. He bought up all the rejected furniture at almost nothing. He made profits beyond imagination by selling it still very cheaply.

**Wilkins:**

Oh yes, I see. The furniture business came in from your mother's side.



**Bohm:**

Yes, and my father got this money and went in on his own.

**Wilkins:**

And he turned out to be very successful as well.

**Bohm:**

He was moderately successful. He was just mediocre. I'd say he got along. He had dreams of being much greater, of course, because his dream was that my brother and I would set up a furniture store in the town, Wilkes-Barre, and become the greatest furniture dealers in the town.

**Wilkins:**

Okay, so you don't mean in the United States.

**Bohm:**

No, but in that town.

**Wilkins:**

His imagination didn't go that far.

**Bohm:**

No, it didn't go that far.

**Wilkins:**

So, he had very big ambitions according to his ideas for you and your brother.

**Bohm:**

Yes, and he was very sadly disappointed by it, both of us.

**Wilkins:**

Yes. To what extent do you think you went off in these other directions reacting against him because you felt there was something false in this whole sort of social convention thing.

**Bohm:**

Yes, I did feel something false. Firstly, this falseness of the class structure, you see, and the division between Jews and non-Jews. I felt it was false and I felt that to just make a little circle of Jews didn't mean anything. There was nothing special about it, but at the same time I could see there was anti-

Semitism among the non-Jews which I also felt was bad.

**Wilkins:**

So in a way you had a feeling for the unity of mankind, so to speak, partly arising out of all the contact you had with these individuals.

**Bohm:**

Yes, but there was also the American, the whole American culture which said people were equal and you shouldn't distinguish, you see. I took it seriously it said that.

**Wilkins:**

These were sort of abstract concepts that you read about and heard being talked about.

**Bohm:**

Yes, and so I took it very seriously, and so we mustn't set up Jews and non-Jews or rich and poor and so on and judge people according to their money or their religion or whatever.

**Wilkins:**

But presumably, though, there were in that society certain sorts of features which did correspond with this American idea. But you also saw the opposite, the anti-Semitic attitudes and the isolation of the Jews themselves.

**Bohm:**

Yes, that's right. I didn't encounter a lot of anti-Semitism myself; once or twice. I remember once as a small child about seven or eight. You see the Polish people were generally very friendly to me but there was some Slavs of some sort, probably. I call them Slavs. I don't know where they came from, who were very anti-Semitic and they began to taunt me and I got very angry. The Polish people said don't answer him, don't let him get your goat. In fact the anti-Semitism that I experienced was only occasional, you see. Most of the Polish people were quite friendly and what they thought was that the Jews were excluding them. They said, "Why don't you come and eat with us?" and I'd say, "No. I can't because it's not Kosher." And they felt, "Why don't you come to church with us?" and I'd say, "No. We have to go to the synagogue."

**Wilkins:**

You felt this was a false way to behave.

**Bohm:**

Yes

**Wilkins:**

That they were fragmenting society.

**Bohm:**

Yes, and I felt poor people were suffering in an undeserved way.

**Wilkins:**

Which poor people?

**Bohm:**

Miners and so on. They didn't have a lot of money, many of them.

**Wilkins:**

Were the miners not Jews?

**Bohm:**

They were Polish and Irish.

**Wilkins:**

I see.

**Bohm:**

Some of them did all right but many of them were rather poor and they lived in company houses and they were pretty much shacks.

**Wilkins:**

And so you have the majority of the population were poor and Polish and Irish miners, and then you had a minority of Jewish people.

**Bohm:**

There were also the Anglo, you know, the people like Welsh and English and so on who were further advanced, you know, and they were not in that class.

**Wilkins:**

They were higher up.

**Bohm:**

Yes, there were not a great many of them around, so I didn't notice it. You know, I didn't have a lot of contact. I had a few friends like that.

**Wilkins:**

But the Jews were a minority who was mainly in commerce.

**Bohm:**

That's right, yes.

**Wilkins:**

I mean, this arising partly out of the fact that in history Jews have been forbidden to do anything else other than the only thing they could do is to handle money, which the rest of them said was sinful.

**Bohm:**

A tradition from Europe was just carried out. A few of them were in manufacturing, but mostly in commerce.

**Wilkins:**

Yes, yes. So this whole idea of unity then and unification and the breaking down of barriers and fragmentation, in a way, you can see the whole of this arising out of your experiences there in that society.

**Bohm:**

Yes, along with all the ideals, the American ideals, freedom and equality.

**Wilkins:**

Yes, you had the American ideals and then you had your own direct experience.

**Bohm:**

Yes.



**Wilkins:**

With boys who you felt sort of brotherly kinds of relations with. Although you were a Jew and they were Poles and Irish.

**Bohm:**

We had more money than they and so on, you see.

**Wilkins:**

You had more money, yes.

**Bohm:**

Obviously, but it didn't interfere at that stage very much.

**Wilkins:**

And you felt the social inequality business, the economics, the more money business was another barrier which you felt was unjust, and in a way this was one of the reasons you felt that the Jewish sort of unity, and your father wanting to be a center in this whole social thing you felt was false as far as they were turning their vision away from the fact

that they were poor and were suffering. It was lack of justice.

**Bohm:**

It was pretty narrow, yes. It was a lack of justice and a lack of sense saying, “Why should they get picked on more than the others?” I didn’t see any great difference. Also, the Jews often looked down on the Polish, not only because they lacked money but they didn’t seem to be so clever and so on. That was probably due to their background. I didn’t notice it at the time, but there was a difference which I noticed later as I grew up that the Polish boys didn’t go far in school and they dropped out and gradually I lost contact with them. There wasn’t much to say to them.

**Wilkins:**

Well, this might have been partly due to the fact that the Jewish boys had more education. They were taught toward an intellectual pushing in the home.

**Bohm:**

Yes, although even when I was in high school I had a Polish friend who used to talk science all the time, science fiction. We used to discuss science fiction.

**Wilkins:**

And he was Polish was he?

**Bohm:**

One friend. The first few years in high school he was my main friend with whom I developed my interest in science. In fact, even before that there had been a boy, my first — well let me try to say how my interest in science developed. There was this whole situation and the working people again emphasized this sort of practical thing. They sort of tied up with my father in that way saying that they didn't have any notion of abstract ideas or anything and they would have looked down on it. You see, in fact among the working people intellectual things were looked down on, especially. I remember when I came home from the library with books I felt constraint to put them under my coat because these Polish or Irish boys would make fun of me. In fact,

some of them did on occasion saying, “What are you doing with books? Why not play football or do all the great manly things like you’re supposed to do?”

**Wilkins:**

They might have been from peasant families in Poland possibly.

**Bohm:**

I got less trouble from the Polish than from the Irish. But some of the Polish?

**Wilkins:**

The Irish were peasants, presumably.

**Bohm:**

Yes, the Polish were more inclined to be favorable to education I think.

**Wilkins:**

Just a take I think I must [break in tape]. Okay, now we’re recording again and, I think this thing about the way your interest in science began. That’s easy enough and obviously it’s very important that we’ve come to that. I wondered if we could just return a

little bit. I wanted to dig around a bit more on the father and mother thing. The thing is, to what extent do you think that your father had a sort of genuine feeling for unity within his social group, or, when you said he was so much appreciated as a sort of entertainer and all that, and the life and sort of the party. Did you feel that apart from this social injustice, the blindness to the social injustice and so on, did you feel that he was genuine in that respect or did you think, did you have any kind of feeling that he was wanting to be the center of the scene for egotistical reasons?

**Bohm:**

I think clearly he wanted to be the center of the scene, but at the same time his values were such that that was the thing that was worth doing. It was what people — in other words, the right thing to do was what people in your circle generally expected you to do, and that was virtue.

**Wilkins:**

Yes, and so you feel that he was acting properly according to conventional views within his society and that he wasn't just being a kind of show off.

**Bohm:**

He did have that, too, but I think that it wasn't just that.

**Wilkins:**

You feel that it was more a question of creative, social action rather than egotistical display on his part.

**Bohm:**

He felt that that was what life was all about.

**Wilkins:**

Yes, so he had his values and he acted properly very much in respect to them, but you felt that this set of values wasn't a sound one.

**Bohm:**

No.

**Wilkins:**

That it was part of that society and you felt that it didn't really make sense in relation to the wider world.

**Bohm:**

Yes, and money making was the other value.

**Wilkins:**

How did you feel about money making?

**Bohm:**

It didn't impress me very much. I didn't really take to it. I would have really liked to have some money, but I didn't see it the way he looked at it. You see, my brother was much stronger. When he became older he began to bring up to my father that what he was doing was useless and wrong.

**Wilkins:**

How old was your brother?

**Bohm:**

He must have been 14 or 15. He felt that it was really wrong to make money by not, what he felt, doing something really useful. That was also part of the working class mentality.

**Wilkins:**

Real work was distinct from shuffling money around.

**Bohm:**

Or shifting around goods from here to there.

**Wilkins:**

I see, yes, that's an interesting point.

**Bohm:**

The working people all wanted to make money, that was clear. In fact, most of their jobs were pretty hard so they would have said only a fool would want to work if he had enough money not to, but most of them would have said that. They wanted money but they didn't really regard those things as really useful, you see. They felt that the real work was being done by them.

**Wilkins:**

So they did have some, although they preferred they didn't necessarily enjoy working all that much, yet they still had some respect — honest, good human activity.



**Bohm:**

Yes, and it was also part of the American tradition from the pioneering days when people had to depend on themselves and so on and work together.

**Wilkins:**

Yes, I see. So the whole idea of society holding itself together through work and cooperation was part of this picture. Maybe I'm sort of overdoing this trying to draw parallels between your ideas about the physical or the whole universe now and the unity and so on with these notions, but I mean it's worth just sort of probing around and see what works.

**Bohm:**

Well, I didn't actually come out and charge my father in doing something wrong, but I really wasn't impressed by what he was doing of any value. And as I thought about it I couldn't imagine living by just shifting furniture around or buying furniture from one place and selling it for a higher price. In some sense it was a service to these people to make the furniture available but at the same time I didn't see it as a very useful, creative activity.

**Wilkins:**

Your brother, was he older than you were?

**Bohm:**

He was younger.

**Wilkins:**

Younger. How many years?

**Bohm:**

Four years.

**Wilkins:**

Four years!

**Bohm:**

Yes.

**Wilkins:**

I see. So you were the first son. Isn't that something very important in a Jewish family?

**Bohm:**

It's probably important in tradition, yes. Also my mother was probably much closer to me than to my brother and in some way this created a reaction in which my father eventually got closer to my brother. That's partly because I never went along with my father at all.

**Wilkins:**

Do you think that your brother sort of got up and faced your father on the money issue although he was 14 years younger?

**Bohm:**

Four years younger.

**Wilkins:**

Sorry, four years younger, at the age of 14, so you would have been about 18 then.

**Bohm:**

I was in college probably.

**Wilkins:**

So that presumably?

**Bohm:**

I didn't even know he'd done it. My father told me and he was very hurt.

**Wilkins:**

Oh hurt, I see. But I suppose by that time your father accepted the fact that it was no good trying to get you into business and commerce.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

But presumably then you hadn't been able to, although you wished to stand up to your father and what he was doing was not a good thing, but you still had a feeling there and presumably that strong feeling was one reason why you felt impelled to go in a very opposite direction.

**Bohm:**

Yes, I didn't think that, you know making furniture available to people was a terribly good way to spend your life. I mean, I didn't know I had moral objections, although fundamentally I did in a sense that I thought that the whole situation was unjust. But I didn't particularly think my father was to blame more than anybody else.

**Wilkins:**

So you could certainly draw a parallel between the principles of universal scientific community and truth and honesty and justice connected with that and the nature of science itself and the nature of the American society at the time. At least the ideals which were to some extent represented in the reality, weren't they? So rather than your father encouraging you to go to college and be interested in books, you were driven there by a reaction against him, really.

**Bohm:**

Yes.

**Wilkins:**

Presumably, he didn't read books, did he?

**Bohm:**

No, he read some books. Later on he began to read literature of various kinds. It wasn't that he was against it; he was against science in particular. He used to call it scientism. He used to make fun of professors all the time.

**Wilkins:**

Well, he was right to some extent, wasn't he?  
[laughter] You've made fun of professors.

**Bohm:**

Yes, I mean it was constant. He was overdoing it in a way. He wouldn't ever say science, he would say scientism. He was perfectly aware of the meanings of all the terms. It was one of his jokes. I remember when I was 14 or 15 he was often reading at night. I don't think, for some reason he felt science was up in the clouds and abstract and not down to earth. It was just no great significance. It was the sort of thing professors did.

**Wilkins:**

Somewhat meaningless.

**Bohm:**

Meaningless to him, just sort of empty talk and empty activities.

**Wilkins:**

But I suppose, do you think this is connected with the fact he didn't seem to have any connection with human and social relationships?

**Bohm:**

No, it didn't seem to have any at all to him and it was even hard for him to believe at first that planets were up there in the sky. Later he realized it and when he did he would say, "What does it matter?" He felt that the relationship with people was the key thing.

**Wilkins:**

In many ways he was quite right.

**Bohm:**

Yes.

**Wilkins:**

I suppose science in a sense is just one particular form of relationship between people.

**Bohm:**

He didn't see the point of it, you see. Later on he may have, but for a long time certainly he didn't.

**Wilkins:**

What sort of literature was he reading?

**Bohm:**

I don't know. He would read books of various kinds. Just stories. Sometimes if I brought books home from the library he would read them if they were stories.

**Wilkins:**

I see, novels mainly. Which would be about people.



**Bohm:**

Yes.

**Wilkins:**

Yes. So, he was really very interested in people and social life and human interaction. But he also got caught up in this sort of money thing.

**Bohm:**

He never managed to make a lot of money. He felt money was important for status, you see.

**Wilkins:**

Yes, because it was part of the whole social magnet statement, and money made church society go around, so to speak.

**Bohm:**

Yes.

**Wilkins:**

It wasn't so much then that he objected, disliked science, as that he thought that it was sort of irrelevant.

**Bohm:**

Yes, he didn't see the point of it, it seemed. It was just fooling around.

**Wilkins:**

Yes, but he didn't actually very actively stand in your way in going to college.

**Bohm:**

No, no.

**Wilkins:**

Of course some people have great rows with their parents like Rosalind Franklin with her Jewish father who strongly objected to her going to University because she was a woman. She had to battle against that.

**Bohm:**

But of course it was part of the Jewish tradition at that time to go to college at that time, so he wouldn't have objected.

**Wilkins:**

Ah, for men.

**Bohm:**

For men, yes, and even some women, too. Women were going already, yes.

**Wilkins:**

Oh, I see. So there was a respect for learning.

**Bohm:**

In the Jewish tradition there was a general respect, and he himself was learned in his way in the Jewish tradition.

**Wilkins:**

Yes, yes. It was more the conventional social life, values, and the interest in money and all the pressure of expectations to go in that direction which you reacted against.

**Bohm:**

Yes.

**Wilkins:**

But he didn't actively stand in the way because to some extent you were doing what was conventional and going to college.

**Bohm:**

Yes, well that was sort of all the other Jewish boys were going. It was sort of?

**Wilkins:**

So you really had no difficulty in getting to college.

**Bohm:**

No.

**Wilkins:**

It was more of a question of what you might do after college and also whether you were getting too involved in sort of rather inane things like science.

**Bohm:**

Yes. Well, he sort of gave up on that. I think he was skeptical of what would come of it.

**Wilkins:**

Oh, I see. He did come around to see that it did have meaning after all.

**Bohm:**

Well, that took time later. I mean, he must have gradually come to accept it. No, he would have said, “Well, okay, you’ll make some money that way. It’s not as good as being in business but?”

**Wilkins:**

Yes. What about your mother? You say that she had, it was a bit difficult to make out what she was like when her husband was really rather sort of trying to expunge her, so to speak. Was it a bit like that?

**Bohm:**

Yes. Well, he was very angry with her, you see. Not only that he felt she didn’t keep the house properly for him and didn’t cook properly. He complained bitterly everyday about that. They used to fight very hard.

**Wilkins:**

How do you mean fight?

**Bohm:**

He would start to insult her and she would fight and get angry.

**Wilkins:**

They would fight physically you mean?

**Bohm:**

Well, they, I don't think they — he may have struck her once physically, but primarily they would get very angry at each other and shout and she would get very angry at him and sometimes even threaten to kill him. Sometimes she was sort of inclined to hysteria and being carried away. She used to get very angry at some of the neighboring women sometimes feeling like they were talking about her. That they were to be looked down on, you know; got very angry and got into very bad fights with them. But she had a very hard life.

**Wilkins:**

I think that people like that; it is very difficult for them to develop their potential as human beings if they're constantly being criticized and sort of ground down.

**Bohm:**

Well, she was, no doubt. She did well in school. My father used to admit that she is very intelligent, but he hated everything else about her you see.

**Wilkins:**

She did very well in school?

**Bohm:**

Yes, even though she came from Europe at the age of seven and had to learn the language and was sort of a fish out of water. Her brothers said that she sort of didn't fit, you know, she was sort of always a bit strange.

**Wilkins:**

What kind of things did she do well in school?

**Bohm:**

Well, I don't know; whatever they taught in school in those days.

**Wilkins:**

There was nothing special about science or mathematics, or maybe they didn't do much of that anyway.

**Bohm:**

No, I shouldn't think they did.

**Wilkins:**

So all you know is she did well and she might have been good on those things, but you simply couldn't know.

**Bohm:**

Her brother became and an engineer, an electrical engineer, and he was very interested in science. Both brothers became sort of an interest in that sort of stuff.



**Wilkins:**

So, on your mother's side at least in that family there were a number of people who were bordering on science and engineering.

**Bohm:**

Yes.

**Wilkins:**

This thing about her being interested in the — you were saying something about earthy things. What was that?

**Bohm:**

Not that she was — just simply the feeling I get which I can't?

**Wilkins:**

Yes, a general sort of sense of the nature of her interest.

**Bohm:**

Her direction would be somewhat earthy, or down to earth way to put it.

**Wilkins:**

Yes, yes. Did you have a garden, I mean, did you have flowers?

**Bohm:**

No, she never did any of that you see, she was too downtrodden, too depressed to do that sort of thing.

**Wilkins:**

I see. So, she really got no opportunity to express herself in this environment.

**Bohm:**

No.

**Wilkins:**

I mean, was she even finding difficulty to do much for the children?

**Bohm:**

Yes, she couldn't really do things properly.

**Wilkins:**

You mean she was being told all the time that she was a wash out and no good, and so it was a little bit like being called a dunce.

**Bohm:**

Yes, in fact she was a difficult person in many ways. I mean, she couldn't really handle money properly, and you could see how it was being sort of squandered.

**Wilkins:**

Yes, but how much of that was simply sort of being compelled to play the role which her husband was imposing on her?

**Bohm:**

Yes, I'm sure it was, but I didn't have much confidence in her ability to do things, you see, after a while, and she got very nervous and she used to come running after me at nine o'clock getting very nervous when I'd come home.

**Wilkins:**

Nine o'clock in the evening?

**Bohm:**

Yes. No, she got really unduly nervous. And the whole thing was beyond her control. As a matter of fact when I was seven or eight there had been some talk of them separating, which must have worried me.

**Wilkins:**

How old were you?

**Bohm:**

I was about seven or eight.

**Wilkins:**

You were seven or eight.

**Bohm:**

Yes, but I can remember that I did think this: although I would prefer to stay with my mother I couldn't do it. I didn't have any confidence in her

ability to take care of me and therefore I thought it would be better to go to my father.

**Wilkins:**

Yes, at least your father was a kind of real person, even if you didn't approve of the sort of person he was.

**Bohm:**

At least he would know what he was doing, yes.

**Wilkins:**

She was just sort of some vague sort of rather ineffectual figure that didn't really become very real.

**Bohm:**

Well, she was real enough but had no control over her emotions. See, she couldn't really use her intelligence.

**Wilkins:**

But you mean she did put on great emotional displays.

**Bohm:**

Yes, and she couldn't sort of keep track of herself and with money or with practical, with what she was doing.

**Wilkins:**

So there was a lot of her putting on great displays of emotions and all this altercation in the family.

**Bohm:**

Yes.

**Wilkins:**

And then you got subjected to quite a bit of this, too. She was emotional about you and sort of getting nervous and worked up, did she?

**Bohm:**

Yes.

**Wilkins:**

I mean it is possible, I mean some people, many scientists don't show very much emotion, and [???] said you've come into this general picture. You

might say part of that might be connected with the fact that you were reacting against your mother who was so putting on these great displays which seem really negative.

**Bohm:**

Totally irrational. Well, they were destructive and irrational. They made a mess all around and she could scream about all sorts of things and become so nervous and lose track of things. I felt my father was relatively rational though he was really pretty emotional, too, in his way, he would sort of control his panic where she couldn't.

**Wilkins:**

Yes, he might get in a rage but he would do some sort of, do it to some extent a bit controlled.

**Bohm:**

Yes.

**Wilkins:**

Whereas she just had no control at all.

**Bohm:**

Yes.

**Wilkins:**

Yes, and it would run right away. So in fact you grew up in a family then with both parents putting on great emotional displays; one with some degree of control and the other with no control at all.

**Bohm:**

Yes.

**Wilkins:**

So you might well say that you emerged out of that thing as the one thing you must never do is let emotions get a hold of you, it will be the end of you [laughter]. I'd be glad you saw some truth in that.

**Bohm:**

Anyway, there was that uncontrollable rage and fear. My mother would also panic very quickly and I think I picked that up from her, and my father I could see was often panicking, but he was under control, you see. He really was afraid but he kept it



under control and he managed it. For example, I can remember one incident that there was a great deal of panic whenever you got ill, especially on my mother's part, and I picked that up. I remember I was about ten years old and I cut my fingernail very badly, it was hanging. I was really getting worried about it and my uncle came in, one of the uncles, my mother's brother, and sort of very matter-of-factly said something spontaneously which I can't remember, but it sort of indicated that there was no point to all this.

**Wilkins:**

Yes, there was really no need to get in a panic.

**Bohm:**

And then I suddenly saw that there was no need to be afraid, you see. But of course that lesson was not sustained because generally around me people were getting into panics. Incidentally, he couldn't maintain that when he had children. I could see that they were frightened because he probably went into a panic about them.

**Wilkins:**

What, your uncle?

**Bohm:**

Yes.

**Wilkins:**

He could do it with other people's children, but couldn't do it with his own.

**Bohm:**

He couldn't do it with his own, yes.

**Wilkins:**

That's a common characteristic isn't it? Like the children of psychoanalysts are often so neurotic.

**Bohm:**

I used to admire this uncle because he was so full of vigorous energy and cheerfulness; sort of liveliness.

**Wilkins:**

I see. He must have appeared more positive than either of your parents. Can't you recall anything? It's honest work and honorable, also.

**Bohm:**

Well, also to be good and tough and be able to fight, you see.

**Wilkins:**

Yes, both are similar things.

**Bohm:**

I noticed my father was always a bit nervous about whenever it looked as if any such thing would develop. You could see he was avoiding it, you see, which used to disturb me.

**Wilkins:**

You didn't respect him for displaying this fear?

**Bohm:**

Well, I could see that there was sense in not getting into a fight, but at the same time it disturbed me a

bit. I had that same problem, you see, sometimes with these Polish or with these Irish boys. There was one I remember — see, many of them were very tough. They use to have gangs that used to attack each other but I kept out of their way obviously. There was one Irish boy that was my age that used to constantly bother me and taunt me and make trouble. Finally, after some time I went to his parents and they said it's up to you, we can't do anything.

**Wilkins:**

You went to the parents?

**Bohm:**

I went to the parents. They were sort of uncles, you see. This boy was related to some other boys I used to go with, Irish boys, and I talked to the parents of these other boys.

**Wilkins:**

Ah yes, you knew the family.

**Bohm:**

Yes, they said, “Well, we can't do anything. It's up to you.” So finally it was intolerable and we started

to fight, you see, and then after a while it was finished and then we became very friendly. It seemed that's what he wanted.

**Wilkins:**

I see, so you did fight him and came out of this fight reasonably well or [???

**Bohm:**

Well, we sort of were equal.

**Wilkins:**

You were able to hold your own once you started to fight.

**Bohm:**

Yes, and then he was very friendly to me.

**Wilkins:**

So in a way he wanted to establish a relationship but couldn't do one until you had a fight.

**Bohm:**

It was part of the culture to say that you couldn't be related until you'd proved yourself with a fight.

**Wilkins:**

How did you feel about when you were fighting?

**Bohm:**

I suppose I got carried away, so it was all right.

**Wilkins:**

You might have quite enjoyed it.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

But at least you — I think one sometimes does this in a sort of spirit of desperation.

**Bohm:**

Yes. I remembered that some of the other people around were then encouraging me saying, you know, go ahead.

**Wilkins:**

They quite enjoyed you having a go at this fighting bit.

**Bohm:**

Yes they sort of were glad to see me stand up to him. It was part of the culture.

**Wilkins:**

Yes, yes. So when you got in a really desperate situation you were prepared to face this thing of physical violence and to fight.

**Bohm:**

Yes, where there was a great reluctance, you see.

**Wilkins:**

Yes, I think what I was about to say was that I kept out of these things all the time. I mean, when one was faced by a real threat by a bully I realize the chips were down. It was now or nothing and I fought back. And the bully was so damned surprised the never touched me again. It was a one-minute fight.

It's silly in a way. He was just undermined and thrown off his balance.

**Bohm:**

Anyway, there was this general toughness and I wasn't really — also there was the great importance of sports, and I seemed to lack coordination and I couldn't really throw a ball exactly where it should go or very far, and people kept on trying to teach me, and so far I've never learned it. That created a problem, you see, because sports was a key part of the relationship in this society.

**Wilkins:**

I wonder how much of this sort of lack of ability like this coordination really is innate or what extent it is that one decides subconsciously that one's not going to throw well?

**Bohm:**

I don't know. I think there was a sort of general feeling that all these movements and muscles that you couldn't follow — I probably developed the feeling that I would try to control things through the intellect, try to be able to see beforehand where



every movement would lead and then do it. Whereas these physical movements you can't do that way, you see.

**Wilkins:**

Oh, you mean you feel that you had an interest in trying to control things by your intellect?

**Bohm:**

Well, by figuring it out.

**Wilkins:**

What age would that have been?

**Bohm:**

It would have been very early, say seven or eight. I probably felt I wasn't able to coordinate it and I'd have to figure it out.

**Wilkins:**

Oh, so you mean at about seven or eight, why do you think you were so interested in trying to in a way control your body and ?

**Bohm:**

Or the general situation.

**Wilkins:**

By using your?

**Bohm:**

By figuring it out. That was probably to feel more secure. I felt I wasn't coordinated. Some people could make a coordinated move without thinking about, so in that area I couldn't do it very well. And then in other areas it seemed also socially it was very hard to see exactly what to do, and I wanted to try to — in unusual situations I felt the need to somehow be able to plan out what you would do.

**Wilkins:**

So what you might say then if you had grown up in this family where you saw the most disastrous quarrel between your parents and immense sorts of displays of emotion on both sides running away from themselves dangerously in the case of your mother and generally an ability on her part to be able to control her life or control anything. Then you

might well have been driven by all this example to say, “For God’s sake, I must hold on to something, some alternative.”

**Bohm:**

Yes.

**Wilkins:**

Which was the intellect. You say that this was a sort of lifeline which you decided was?

**Bohm:**

Since I was able to do it then I pursued it.

**Wilkins:**

Yes, and you had the facilities in that direction so you sort of do to develop it.

**Bohm:**

Yes, I used to just say figure it out.

**Wilkins:**

Can you give me an example of one of the things that you figured out?

**Bohm:**

Well, you see I can't remember, but I have this general feeling of wanting to figure out what I would be doing beforehand. When I was about twelve, or ten or eleven, I was walking with some boys in the backwoods of the mountains there. I don't know if I told you this, we had to cross the stream. This was a typical problem that you had to do things and just trust your body. It must have happened many times, but the thing I remember was the stepping stones. But I suddenly took this leap and it worked, you see, whereas before I would have said I must take every, I want to see if I can step from one stone to the other and stop and see where I then make the next step and so on. So that was the sort of thinking, and suddenly I had that insight that it wasn't necessary, that the movement as itself was a state of being.

**Wilkins:**

It would look after itself.

**Bohm:**

It would look after itself. And that sort of incident, it impressed me so that it stuck in my mind.

**Wilkins:**

This was a leap away from an analytical approach to a sort of holistic notions.

**Bohm:**

At the same time it shows how strong the analytical approach was.

**Wilkins:**

Yes, quite, that you had been developing all this figuring it out, as you say. Yes, well when one becomes a theoretical physicist to make sure, I mean, you'd say this term 'figuring it out' was of course very clearly what you'd been doing all your life, but then you've gone beyond the early limited term for 'figuring it out' to 'figuring it out' in terms of holistic notions.

**Bohm:**

Yes.

**Wilkins:**

You can't remember any examples of the sort of things that you figured out that encouraged you to go on with this approach.

**Bohm:**

I guess I don't remember it but the feeling I had was like when you were to walk from one place to another, each time you were walking you can stop at any moment and see where you are and reconsider. You're not committed to a course such that you can't sort of stop it and reconsider it at that moment and change if it's wrong. Do you see what I mean? Or while you're on that stepping stone, on that stone across the stream, once you've made the leap you can't do that.

**Wilkins:**

Yes, well, I suppose what you felt in a way was that there was no real security in your parent's life, being sort of all along on a river of emotions and that, you know. What you needed to be able to do was to put your foot down on say stones and just stand on something firm.

**Bohm:**

Yes, and be able to stop and look, look around and make the next step on a firm basis.

**Wilkins:**

So you wouldn't be sort of just dragged along by these currents.

**Bohm:**

Yes, by these uncontrollable irrational currents.

**Wilkins:**

Yes, yes. But then you, on the stepping stones, you saw it wasn't as simple as that. You had to be prepared to go along with the whole motion and the mind and the body couldn't be separated.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

So this was really your first example, the lesson very clearly in your mind that you had unity of mind and body.

**Bohm:**

Um hmm [agreement]. Well also the unity of being in motion. You see it was really the feeling I had was that I would separate being and movement in the beginning saying that being was on those stones and then you would move from one stone to another.

**Wilkins:**

I see, yes.

**Bohm:**

But there was the idea that motion was first and being was part of it.

**Wilkins:**

I see, yes, yes. That there was no such thing as being and becoming. It was all — you couldn't, no one could ever stand still.



**Bohm:**

Yes.

**Wilkins:**

That's my point.

**Bohm:**

Yes, you can't stay as a certain being and then choose the next one.

**Wilkins:**

You think this is reasonable to attribute this to the reaction, these awful sorts of great currents of emotion sweeping your whole dimension of being.

**Bohm:**

But also to somehow — whether this was an effect of it I don't know — but it was not up to the usual degree of coordination so that I found that I had to watch my movements. Other people seemed to learn these movements far more easily without even thinking about it or without considering it.

**Wilkins:**

Yes, I think it was quite in general ordinary people I noticed seem to have a particular facility for picking up certain conventions that I find, for example, that if I have to play a game, or even writing, answering examination questions. I find that if my children are schooled, they all have difficulty in this. They seem to give all sorts of different answers than what the examiner really wants. Or writing an essay. Where the much more mediocre minds of the other children seem to sail along. They seem to sense all this that is required of you and do it. It's the conventional thing.

**Bohm:**

Well, with regard to examinations I had no trouble, I could do that. When it came to some of these other situations perhaps there was too much tension or fear or panic of some sort.

**Wilkins:**

I think probably what it means is that ordinary people that don't have any exceptional powers of intellectual analysis and imagination and so on don't have much intellectual development, these people

have more or less instinctive feeling for what the social group requires of them.

**Bohm:**

Yes.

**Wilkins:**

And the more intellectually developed people are?

**Bohm:**

The also have the ability to pick up the sort of movement required almost by a kind of mimesis which they are not conscience of.

**Wilkins:**

Without understanding it.

**Bohm:**

Yes.

**Wilkins:**

I think you see University students generally picking up all sorts of stuff without understanding it. They know it after a fashion. They can often sort of kind

of trot it out in exams and get reasonable marks. It's not simple regurgitation, but he gets his prompting having a supple sense of what the teachers really expect of them.

**Bohm:**

Yes, they can pick it up. It's really mimetic in a sense of?

**Wilkins:**

What's the word?

**Bohm:**

Imitative.

**Wilkins:**

Yes.

**Bohm:**

It's a kind of imitative response.

**Wilkins:**

Yes, but it's a special ability within the social group to pick up and respond to the wavelengths of the social group, isn't it?

**Bohm:**

But that is by mimesis, by imitation, by subtle imitation.

**Wilkins:**

Yes, I suppose that's — yes, they do imitate. And whereas you were stepping outside — I mean, you revolted against your father's sort of imitative?

**Bohm:**

But I would have liked to have belonged to these boys' working class groups and been more part of it than I was, but there were always these difficulties. The difficulty of bodily movements and the fact that they worshiped physical strength so much. I didn't feel quite as strong as they were. I may have been as strong, but I didn't think I was. My father always told me I was weak.

**Wilkins:**

He made you weak.

**Bohm:**

Yes, and I don't know exactly why he did. Probably he himself must have felt weak because I saw he was afraid of physical fights.

**Wilkins:**

He never did anything. He never gave you exercises or things, devices to strengthen muscles or anything like that.

**Bohm:**

No, no, he never did anything like that.

**Wilkins:**

Yes, he didn't take much positive interest in that.

**Bohm:**

No, he wanted me to be strong but he said I was weak you see, and he said I couldn't stand up to the sort of treatment other boys could take.

**Wilkins:**

And he sort of discouraged you.

**Bohm:**

Yes.

**Wilkins:**

Did he ever do anything encouraging to you at all?

**Bohm:**

Not often.

**Wilkins:**

He did sometimes? Can you give me an example of something?

**Bohm:**

He may have done so occasionally. It's hard to remember. He was almost always negative. I think he was negative all around and with my brother, too.

**Wilkins:**

Yes, and to your brother.

**Bohm:**

Yes. In fact my brother had a much harder time because people used to compare him with me and I'd made a good record in school.

**Wilkins:**

Yes, I see. But did your mother ever give you any encouragement?

**Bohm:**

Well, not really. She didn't discourage me, let's put it that way. I didn't lose confidence through her except I lost confidence in her. But I may have lost confidence in a sense that I should have had a mother I could have counted on.

**Wilkins:**

So in a way you lost confidence in your father because he seemed frightened of the physical violence, and you knew that you were afraid of it. You probably sensed the fact that if necessary you could face it, but you felt that he might not be able to do that.



**Bohm:**

Or he might not want to or he might not be able to.

**Wilkins:**

Yes, yes. And you didn't have confidence in your mother either for other reasons.

**Bohm:**

Yes.

**Wilkins:**

Yes, there really wasn't much at all in your home life to inspire any confidence at all.

**Bohm:**

No. I told you I had some confidence in this uncle, but I didn't see a lot of him. My grandfather was sort of a rough character. He was really a peasant back then, almost.

**Wilkins:**

He was a furniture man.

**Bohm:**

Yes. He was sort of, very devout and had very simple ideas.

**Wilkins:**

Yes, but he being the one who had been able to build up the furniture business, so he obviously had a lot of skills.

**Bohm:**

The business, yes. He had a lot of skills, no doubt. My grandmother, you see, was the one my mother depended on. She always struck me as the quiet sort of reasonable type of person. You could depend on her.

**Wilkins:**

Ah, you had some contact with your grandmother?

**Bohm:**

Yes.

**Wilkins:**

And she was somewhat encouraging?

**Bohm:**

Well, she was in her way, yes. The main encouragement was that she was orderly and rational and sort of you could count on her. It would make sense, you know.

**Wilkins:**

Yes, there was some order in her world, yes, and some sort of meaning, whereas you didn't really see much meaning in either your mother or father's lives.

**Bohm:**

No.

**Wilkins:**

Well, then didn't your grandmother give you — did you feel that to some extent she respected you as a human being in your own right?

**Bohm:**

Yes, I'm sure she did. For example, she used to ask me to help her with her English, you know. She was going to night school and we would spend a couple of hours on that and she'd give me five cents.

**Wilkins:**

So her language was primarily what?

**Bohm:**

Yiddish.

**Wilkins:**

Yiddish.

**Bohm:**

Yes. But she was going to night school studying English.

**Wilkins:**

Which country did she come from?

**Bohm:**

Lithuania.

**Wilkins:**

Lithuania, and they spoke Yiddish.

**Bohm:**

Well, the people spoke mainly Yiddish. She may have known Lithuanian, but that must have been very rusty.

**Wilkins:**

Yes, I see. In their separate lives, in their ghettos they might have been largely using Yiddish.

**Bohm:**

Yes. Well my grandfather spoke basically Yiddish, too. He knew just enough English to talk his business and he knew Polish, which was the main point.

**Wilkins:**

I see. So you were helping your grandmother with her English?

**Bohm:**

Well, sometimes, yes.

**Wilkins:**

And she'd pay just for some money.

**Bohm:**

Yes. And my grandfather used to pay me to say the Hebrew prayers. Five cents. [laughter]

**Wilkins:**

They were both sort of friendly towards you, then, and so this must have somewhat encouraged you to have some degree of self-respect if you felt you could teach your grandmother something.

**Bohm:**

Yes.

**Wilkins:**

The old joke is you can't teach your grandmother something, isn't it?

**Bohm:**

[laughter] Well, she had a somewhat broader point of view than my grandfather. She was sort of very interested in things.

**Wilkins:**

I thought that you once said something about your mother. You had a feeling that she had a certain, what would be imaginative, poetic, or spiritual quality or something.

**Bohm:**

Yes, well, I remember when I visited my aunt once and she brought out a picture of my mother when she was young and she had a sort of look in her eye which was sort of inward looking. It was sort of a spiritual quality of inward looking-ness.

**Wilkins:**

I see. Sort of inner meaning which is not on the surface of life. Whereas you felt your father really was seeing the meaning of life on the surface — conventions.

**Bohm:**

Yes. I felt my mother had the capacity to see the inner meaning, but she was too confused all around to do much about it.

**Wilkins:**

Too broken up.

**Bohm:**

Yes.

**Wilkins:**

Pulled apart, whereas your father then didn't have a sense for inner meaning you felt.

**Bohm:**

Well, he could have but he didn't want to. He felt it wasn't right according to his culture. It was not the thing to do.

**Wilkins:**

He chose not to. He turned that one off.



**Bohm:**

The nearest he got to it was the Hebrew, the Jewish religion which he was learned in.

**Wilkins:**

Yes, but this was a conventional thing again.

**Bohm:**

Yes.

**Wilkins:**

So he decided that he was just going to be conventional and that was it.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

And so he never gave himself the chance to develop any potentialities he might have had in that direction.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

So this sort of inner vision and so on, you might say that you got this from your mother's side?

**Bohm:**

Yes.

**Wilkins:**

At least it was showing itself there.

**Bohm:**

I felt sort of an emotional bond to her when I was young, in the sense that I could trust her emotion. I couldn't trust what she would do, but I could trust her feeling.

**Wilkins:**

I see. So from a feeling point of view you felt somewhat on the same wavelength and with your father you felt less so.

**Bohm:**

Yes. I felt he would do the right thing but his feeling was hidden.

**Wilkins:**

So that you really felt that if she could have held herself together more in one piece and to have managed mundane practical matters in life, like money and cooking and, these things.

**Bohm:**

And not to get carried away with these emotional outbursts.

**Wilkins:**

Yes, that she might have been like someone that you really could have got on with well. But it was all this — she just would go off the deep end and become totally unreliable.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

But your contact with your grandmother never sort of developed very far, you mean.

**Bohm:**

Well, I didn't see that much of her. It seemed that she was practical and reliable, you know. She knew what she was doing.

**Wilkins:**

I think the difference between the generations sort of stands in the way a lot I think with this type of thing.

**Bohm:**

Well, also there was the language, you know. Her English wasn't all that good. I mean, I could understand Yiddish but I never could speak it, so I think I had a resistance to speaking it because it wasn't American.

**Wilkins:**

So you were saying something about your — turn back to the parents' business when you were beginning to talk about your original interest in science. What was it you were going to say about that?

**Bohm:**

Well, I think the first interest that I can remember was when I was about eight-years-old and in my father's store. There was a boy, he used to have boys come in to help him take care of it. He brought a magazine called Amazing Stories, a science fiction journal.

**Wilkins:**

With pictures?

**Bohm:**

Yes. And it had a story called "The Columbus of Space" or something or "Voyage to Venus." I don't remember what the story was, but this tremendously aroused my interest, you see.

**Wilkins:**

I see. "Columbus of Space." So, space travel.

**Bohm:**

Yes.

**Wilkins:**

Yes, a man was going to make this great adventurous journey.

**Bohm:**

Yes, to Venus.

**Wilkins:**

Venus?

**Bohm:**

Yes.

**Wilkins:**

I see, do you remember any of this?

**Bohm:**

No, I don't remember that story at all except that it was some great adventure.

**Wilkins:**

Maybe that made a big impression on you.

**Bohm:**

Yes.

**Wilkins:**

What year would that have been?

**Bohm:**

About eight-years-old, maybe nine, I don't know.

**Wilkins:**

What would that be? '19?

**Bohm:**

'25 — about '25 or '26.

**Wilkins:**

Yes, these ideas about space travel were just beginning. The Germans were making rockets and planes and things in a small way.

**Bohm:**

Yes, but I mean in our environment that would have, nobody would have?

**Wilkins:**

They wouldn't have known about it. No.

**Bohm:**

Because people — my father would have thought that was just nonsense.

**Wilkins:**

Yes, yes. But these ideas could sort of filter around amongst writers and so?

**Bohm:**

Well, there was a science fiction — you see around that time they started this first science fiction journal in America, *Amazing Stories*, then later several more came up. *Wonder Stories*, *Astounding Stories*, and as I got older I used to buy them from time to time. I talked them over with this Polish friend of mine, Koniki [?] his name was. We used to talk about all sorts of things. As a matter of fact, but I



was interested in science before that and after the Amazing Stories, then in the fourth grade they put out a book on astronomy. They gave us a small book on astronomy that they wouldn't let us keep, but we would just hold it there and make readings in it. But I used to read it all the time rather than the other things. So this impressed me tremendously, the tremendous size of the sun and the tremendous distances and the great order of the movements of the planets.

**Wilkins:**

You say this was a textbook?

**Bohm:**

It wasn't a text, it was sort of a story about it. It was a sort of a bit extra that they gave you.

**Wilkins:**

I see, it was a bit of extra reading of sort of a book on astronomy for the general reader.

**Bohm:**

Well, it was really for the child, but still.

**Wilkins:**

What age would that be?

**Bohm:**

Well, the fourth grade. I must have been about ten or eleven.

**Wilkins:**

So that you were stimulated to have an interest in astronomy and this whole sort of bigger universe at the age of about ten.

**Bohm:**

Yes, and it seemed with all that order and tremendous immensity it was sort of in contrast to the pettiness of the life around us here.

**Wilkins:**

Yes, it was Einstein said that sort of same, too, didn't he, much later on in his career. You mean this was a kind of holy pure world up there, untainted by human foolishness of husbands and wives sort of shouting at each other.

**Bohm:**

Yes, and also people fighting for no good reason.

**Wilkins:**

Yes. Violence, boys, and ?

**Bohm:**

And teachers who were ?

**Wilkins:**

[???] tough work.

**Bohm:**

Yes, and also, the point is I didn't like the school, you see. Not that I was against the learning, but I felt the whole atmosphere in school was wrong. I felt the teachers were addicted to arbitrary authority, you see. I wouldn't have had the words for it, but I used to make up stories with my brother to tell them. We used to tell them about, we made up all kinds of stories about the boogie men. We called them "boos".

**Wilkins:**

With your brother?

**Bohm:**

Yes. So one of the stories was they were organized. I had them organized into an army of captains and majors and generals. I said the worst of them all were the teachers.

**Wilkins:**

You mean the teacher was a category of boogie men?

**Bohm:**

The teachers of the boogie men really were the worst of all.

**Wilkins:**

I see. There were different levels in hierarchy of boogie men and the teachers came right at the bottom.

**Bohm:**

Yes, well the top really.

**Wilkins:**

Oh the top, I see. They were bad, they were the worst of them all.

**Bohm:**

It went up from the captains then the majors and generals and the teachers.

**Wilkins:**

Why, was it this arbitrary authority?

**Bohm:**

Yes, it was the arbitrary authority saying that they really just wanted to exert arbitrary authority, you see. Very often I was rather bored there. You had to wait and wait and watch the clock until it was time to leave.

**Wilkins:**

Yes, it's dreadful watching the clock. And you didn't feel they had any respect for the subject that they were teaching? No real feeling for it.

**Bohm:**

Well, I think some of them had. I felt they got across some feeling for it, but I think, first of all they had to go at such a slow pace, but this exertion of arbitrary authority was what worried me. There was such a contrast because outside before you went to school you could just talk to anybody whenever you wanted to and say, "Okay." You could say what you wanted to, you see.

**Wilkins:**

Free society.

**Bohm:**

Yes. And then suddenly you couldn't say anything except when they wanted you to talk and only the things they wanted you to say. And they could punish people and exert every kind of?

**Wilkins:**

What age did you start going to school at?

**Bohm:**

Seven or six and a half.

**Wilkins:**

Oh, that was a bit late wasn't it?

**Bohm:**

Well, because of my birthday or something. I think maybe it was just before seven.

**Wilkins:**

I think now in this society children start going to some sort of thing, nursery school, much earlier on, don't they?

**Bohm:**

Yes. Well, they used to have kindergarten, but I didn't go to it.

**Wilkins:**

You didn't go to it, yes, so you had no experience of school until you were about six or seven?

**Bohm:**

Yes.

**Wilkins:**

So it came as a bit of a shock, all these constraints.

**Bohm:**

Yes and then outside the boys were really rotten. They admired — they were inclined to be contemptuous unless you could equal them in strength and skill.

**Wilkins:**

Was there good discipline in the school?

**Bohm:**

Well, it was quite strong discipline, yes.

**Wilkins:**

Yes, yes. So the rottenness of the boys was kept under control?

**Bohm:**

Yes, that's right, yes. I think the school was probably better than most in that area.



**Wilkins:**

Well, it was good that they gave you this strong label, isn't it?

**Bohm:**

Yes.

**Wilkins:**

I mean, that showed some sort of concessions to free inquiry, didn't it?

**Bohm:**

Well, I think they had an attitude in which they respected knowledge and learning. I mean, that was clear.

**Wilkins:**

I see. And they had all sorts of religions and certain groups.

**Bohm:**

Well, I was the only Jew in class. There were mostly Catholics and maybe some Protestants.

**Wilkins:**

Ah, the Catholics, you mean the Poles and the Irish.

**Bohm:**

Yes.

**Wilkins:**

They were both Catholic, yes. But Catholic influence, you weren't conscious of any sort of particular impact of the Catholic religion on your life you think?

**Bohm:**

Well, I don't know. Not very strongly, except people I knew were Catholics.

**Wilkins:**

You didn't know quite what it meant?

**Bohm:**

Well, we talked about it a bit, but they used to say that the Jews had crucified Christ and I used to answer back that it was the Romans and they were saying, "How can you hold people responsible for

what was done 2000 years ago to people today?” I couldn’t understand that.

**Wilkins:**

So this was another piece of injustice on the part of the attitudes of the Catholics towards the Jews.

**Bohm:**

Yes.

**Wilkins:**

Unreasonableness and injustice.

**Bohm:**

Yes. We never really got very strong about it, you see. I didn’t produce any great deal of friction.

**Wilkins:**

But you do seem to have had quite a lot of different ways in which you felt about injustice and unreason. There was your father’s respect for convention and his social Jewish world. There was the Catholic attitude towards the Jews.

**Bohm:**

There was a feeling that my father was unjust to my mother.

**Wilkins:**

Yes, yes.

**Bohm:**

As I grew older that went away because I could see that she was terribly hard to deal with.

**Wilkins:**

Yes, you could understand more why he got so desperate. But presumably she got worse too.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

Under those pressures. It does seem to me that you had a whole lot of situations where you were reacting against injustice.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

If I was just thinking back about my social life I was practically unaware of any social injustice at all. I was insulated from these matters. Interesting point. Interesting point.

**Bohm:**

I probably felt that my father was unjust to me, you see.

**Wilkins:**

Yes, well, whether you consciously did or not you obviously must have felt, yes, and to what extent if feeling that you were being unjustly treated may have stimulated you to be more sympathetic to the needs for justice to other people. One doesn't know, does one? It could be. So you were embedded in a social situation where there were lots of opportunities for observing injustice of one kind or another.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

Yes, I probably didn't sort of see that. I think probably my own family, so called, was a very good one from the point of your getting justice, because I think that my father in particular was — well, he came from a family with feminists, you see, and suffragettes and free-thinking, generally. So his whole attitude was to encourage every individual in their own rights to do their own thinking, you see. So in many respects my background was more or less the exact opposite of what yours was. Later on, of course, my father was very concerned with the injustice in the slums of Birmingham where he worked as a doctor, and of course I just had to — he became totally engrossed in this question of economic reform. How far did you get with the science at school at various ages?

**Bohm:**

Well, there was no science in school at all until I was about in high school, I'd say about eleventh grade or tenth grade.

**Wilkins:**

That was another school?

**Bohm:**

Yes. The first six years were the elementary school.

**Wilkins:**

But at the elementary school you got the book on astronomy?

**Bohm:**

Just that, that's the only science. But that awakened my interest and then a little bit later I met this Polish boy and another boy we called Waisaki [?]. And he used to make things with his hands.

**Wilkins:**

What sort of things?

**Bohm:**

Well, little ships and devices of various kinds. He was interested in science. We used to go to the library together and get books on chemistry and physics.

**Wilkins:**

The public library?

**Bohm:**

Yes.

**Wilkins:**

And it was free?

**Bohm:**

Yes. But of course later I got separated from him, whereas he didn't go on with school. He was also not too balanced. I mean, he was always nervous and he began to break down later. I understand after I ceased to know him and he died at the age of 19 from something or other. But he was always a bit unusual or something. He had these unusual interests, you see.



**Wilkins:**

What sort of models were these things and devices?

**Bohm:**

He was interested in model airplanes and model ships. Later I became interested in making small radios.

**Wilkins:**

I see. Yes, I think model airplanes were always fascinating. Well ships, too. I suppose you have this dynamic thing. I suppose all the space travel is a similar thing — you know, a sort of ship that travels about. You've got this freedom.

**Bohm:**

We made models of sailing ships and put them in the ponds. And we tried some model airplanes that didn't fly too well. He made other things. I can't remember. So there was that interest in science at that time. We used to talk a lot about interplanetary travel and I remember we had an argument once. We were planning to go to Mars, you see, when we grew up and I said I think we'd probably have to stay

there a year to explore the place. He said no, we must return immediately.

**Wilkins:**

Why?

**Bohm:**

He didn't want to. I don't remember why not. He felt it was too dangerous. He said he would tell everybody what my plans were.

**Wilkins:**

I see. He thought you were planning something unwise to stay there.

**Bohm:**

Yes.

**Wilkins:**

He'd have to warn people. So you weren't planning to be engine drivers and you were planning to be astronauts.

**Bohm:**

I don't know how serious we were but that was our imagination.

**Wilkins:**

Childhood notions, yes.

**Bohm:**

With this second Polish fellow Koniki [?] we used to discuss science fiction all the time. Also, science and things. When we had science in high school we would talk about it. We would sort of study things on our own.

**Wilkins:**

Did you notice any contradiction of attitude between the science fiction and the school science?

**Bohm:**

I don't think it bothered me. I realized the science fiction was fantasy so it didn't bother me that there would be a difference.

**Wilkins:**

Yes. So to some extent the two things did fit together.

**Bohm:**

Yes.

**Wilkins:**

The science fiction was the more romantic aspect of the science whereas you could see that the science in the school was also interesting although, it was rather possibly a little bit dry.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

And matter of fact.

**Bohm:**

Yes. Well, it didn't really seem to cause any trouble.

**Wilkins:**

Yes, yes. I think presumably you saw the poetic interest in even the dry school science. Where I think the trouble now with so many children having science in school is they haven't got this intense interest in science generally which lightens it all up for them. I think they only see the dry aspects. Unless you make it very interesting to them they won't get interested in it at all.

**Bohm:**

Science, it seemed, there were several things that science would have this aspect of this vast universal law and also the great power in it. You see, it used to interest?

**Wilkins:**

Law you say?

**Bohm:**

You know, with the planets and the sun. And one discovered these laws in chemistry and physics.

**Wilkins:**

Yes, I see.

**Bohm:**

The other side was there was great power in it. I was fascinated with the idea of atomic power by the age of thirteen.

**Wilkins:**

Atomic power? That was in The Amazing Stories was it?

**Bohm:**

Well, it was always in those stories all the time.

**Wilkins:**

You mean Solly [?] and people like that presumably right about 1920 or something.

**Bohm:**

Well, they were always using atomic power and all sorts of drimes [?] and liberating energies that could destroy planets and so on.

**Wilkins:**

Gosh, so the Manhattan scientist brought up on atomic power Amazing Stories?

**Bohm:**

Yes. So when I went to the library and saw the Scientific American about neutrons and protons and so on I became very fascinated because it seemed this was the road to atomic power.

**Wilkins:**

That was before the idea of fission of course.

**Bohm:**

Yes, but the neutrons seemed they would be the way because it would penetrate, you see. The nucleus?

**Wilkins:**

You worked that out for yourself?

**Bohm:**

Well, that was probably in the article, I don't know. There were popular articles on it, semi-popular in the Scientific American.

**Wilkins:**

You think that atomic power and neutrons were being??

**Bohm:**

Well, I don't know if they said so, but it seemed that if you were going to do anything it would be the neutron because that could penetrate the nucleus. I mean, I remember talking with Koniki about it, so that was of course a great dream of saying it would liberate all this energy and make space travel possible and do all kinds of interesting things.

**Wilkins:**

Yes, yes.

**Bohm:**

The idea of liberating power itself was fascinating, you see. I even used to have fantasies when I was a bit younger about trying to produce lightening. You see, I heard about these coils like Ford coils that would build up high voltage sparks. I thought of trying to build it up still more and produce lightening.



**Wilkins:**

You could really.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

If you had the facilities.

**Bohm:**

But that may have been some people would think it was a sort of compensation for a feeling of being powerless, you see.

**Wilkins:**

Well, it might well have been. But you were also, you had all of these memories of seeing lights and street lights.

**Bohm:**

But that was much, even much earlier.

**Wilkins:**

Oh, it was earlier?

**Bohm:**

I mean to see light as radiating out into the darkness. I used to walk and see these street lights that sort of radiated out into the darkness and sort of had a significance to me.

**Wilkins:**

Was that before you had an interest in astronomy?

**Bohm:**

Well, it could have been. I mean, I didn't see any direct connection at that time.

**Wilkins:**

What about looking up at the sky in the night and thinking that was marvelous?

**Bohm:**

Yes, well the stars were very interesting and later with science fiction came the notion you could go there.

**Wilkins:**

Yes, I see. But the street lights?

**Bohm:**

Seemed to be doing, an energy that penetrated the darkness, you see, and really reaching out from where they were to me and to everything.

**Wilkins:**

Was this some sort of symbolic things of some sort of spiritual [??] enlightenment which might?

**Bohm:**

Yes, that I used to like to think about lights that were more and more powerful — thinking of tremendously powerful lights.

**Wilkins:**

What would they do?

**Bohm:**

They would do more of the same, but you see, when I heard of ultraviolet light infrared, you see, then I thought of a flame which would go from red to

white to blue to violet to ultraviolet. Thinking of the tremendous energy that would penetrate everything. I was very impressed with the idea of energy and power. I used to study the table of chemical activities avidly. If I ever saw another element that was more active than I'd known it was a fascinating thing. Let's say sodium was way in the top of potassium and lithium and then down on the other side was fluorine and then came the idea that their nascent elements were still more active and so on. So the idea of activity of chemical elements was fascinating.

**Wilkins:**

What sort of age would that be?

**Bohm:**

Twelve or thirteen, when I first saw them in the library.

**Wilkins:**

Oh, this was a long time before you had any science in school then.

**Bohm:**

Yes.

**Wilkins:**

So you were reading all these books about chemistry on your own before you had any science education.

## Interview Session - 2

**Wilkins:**

Yes. It's recording now. I had a little sort of psychological theory that might explain the fact that you seem to have an usual interest from an early age in exploring unconventional or alternative views of these world and life science and so forth. And this might be connected with the fact that your father at least in some respects had been rather dominated by conventional views and this had — you felt rather strongly as a child that you regretted the fact that your father was rather dominated by certain conventional aspects of the Jewish community in which he lived. Do you think there might — I mean, no one can prove that these psychological theories are right, but do you it's a reasonable type of speculation?

**Bohm:**

Yes, It's reasonable. I'm sure I was affected by my father and also encouraged that way to question the

limited values of the Jewish community. But also the contrast between the Jewish community which was a bit far away and the immediate surroundings of the people I was with all the time.

**Wilkins:**

Yes, you mean your actual home was in a somewhat area different from the area where you were. No, I don't quite understand this.

**Bohm:**

Well, we lived surrounded by Polish and Irish people and perhaps the main part of the Jewish community was well over a mile and a half away.

**Wilkins:**

Oh, I see. You mean that you lived near your father's furniture store.

•

**Bohm:**

Yes, as a matter of fact essentially next door to it.

**Wilkins:**

Next door to it. I see. And so that you were somewhat separated then from the main Jewish community.

**Bohm:**

Yes, and the contrast with these values to see two communities with such different values would already help me to look more critically at values.

**Wilkins:**

Yes, so that certain aspects of your family life were dominated by the Jewish community, but you yourself were immersed in the Polish/Irish mining community.

**Bohm:**

Yes, and I realized that the Jewish community often looked down on the Polish/Irish, and vice versa, and the Polish/Irish had a poor view of the Jews.



**Wilkins:**

Yes, quite. I suppose this is a somewhat unusual way for people to live, isn't it? I mean, it's often the case that you might, for example, have a Jewish businessman who had his business enterprise in another community but to have an actual family living there meant that you as a child were immersed in this other community.

**Bohm:**

Yes, and if I wasn't raised there I'd identify with the Jewish community, but more closely with the other one.

**Wilkins:**

Yes, but when you went to visit the Jewish community did you feel sort of it was possibly a bit artificial?

**Bohm:**

Yes, limited, artificial, middle class. You know, various feelings, narrow and sort of arbitrary and know that their values were somewhat arbitrary, dogmatic.

**Wilkins:**

Yes, yes.

**Bohm:**

I didn't, but then I could see that both communities were criticizing each other so that may have led me to look, to take a stance a bit beyond that you see. You know, I had some ties to both communities and I could see some truth in both sets of criticisms.

**Wilkins:**

You mean you might say you were encouraged to have a certain degree of objectivity because you were somehow suspended above these two communities.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

And you could observe both their weaknesses and shortcomings in the way in which each of them criticized the other.

**Bohm:**

Yes, and saying that possibly I could see that some of the criticisms were right on both cases.

**Wilkins:**

Yes, yes. And so you were not really absorbed in the ordinary sort of cultural sense. I mean, most people tend to be sort of absorbed into a certain cultural surrounding, aren't they? I mean, in as much that they don't sort of question the attitudes. They take them for granted, whereas in your case this didn't happen to you.

**Bohm:**

No, and also I could see that therefore a person depended very much on the community he happened to grow up in. So that idea was somewhat current in the culture.

**Wilkins:**

Which culture?

**Bohm:**

Probably in the general American culture. You see that a person might be considerably affected by the way he grew up.

**Wilkins:**

Yes, because you mean so many Americans had come from so many different cultures in Europe.

**Bohm:**

Yes, and I remember when I had a lesson. I was about 15 or 16 and I went to talk with the rabbi. He was really quite an educated man. He had gone to Columbia and he was essentially in favor of the humanities, you see. Essentially this feature of Western culture, which I forget what you call it — after the middle ages, you know — not exactly humanitarian but emphasizing the human side of things.

**Wilkins:**

Humanistic?

**Bohm:**

Humanistic, yes. And so his religion was sort of mixed with that and we had a long talk. He asked me at one stage what would I have done if I'd grown up in the Middle Ages? I told him I was very interested in science and all the things that were going on and that I didn't really connect that much with the Jewish religion. And he listened to that and then he asked me, "Well, what would I have done in the Middle Ages if I'd grown up?" And I said, "Well, I would probably have been a very religious Jew," because that would have been the only possibility at that time, you see. So I had the notion that I could see that even my own values had been affected by the situation in which I'd grown up, you see. But I didn't feel that these values were ironclad, absolute. In other words I felt that there was some humanity beyond any of these values.

**Wilkins:**

So that you were able in this rather peculiar cultural position of being somewhat suspended between the two cultures, both of which were in an American environment and taken out of their roots in Europe

— that you were able to see more clearly than many people might the way in which people are conditioned.

**Bohm:**

Yes, I could see that all of us were conditioned including myself and that view was part of me. You see, I remember also later in college we used to argue about whether human beings and human society were perfectible, you see. Some people took the view that you couldn't get very much farther than we were, that that's the way people are. And I took the view that human society, human beings were perfectible. That we're improvable, you see. And then he said — you know I don't remember how he got it — but he said, “But you've got all these shortcomings that other people have.” But I said, “But after all, I've grown up in the same society, you see. If I was sitting in another society we'd all be different.” So that's the sort of view that I developed I think as I grew up. I had that even earlier, you see. I was very unhappy even before I got to school with this sort of family situation I'd grown up in. I felt that it had sort of made me somewhat nervous and mixed up.

**Wilkins:**

You mean the quarrels between your parents.

**Bohm:**

Yes, and also the whole trouble all around, the meaninglessness of the whole situation and all the nervous, neurotic reactions.

**Wilkins:**

Well, what sort of?

**Bohm:**

Well, I don't know, I had a feeling that...

**Wilkins:**

You mean amongst the mining community?

**Bohm:**

No, but myself. I had the feeling that because I'd grown up there I was not really healthy, you see.

**Wilkins:**

Ah, I see. You felt you were somewhat damaged by all this sort of awful space.

**Bohm:**

Yes, I felt that very early, yes. I had read about the West where everything in America was different. I was about six or seven, I suppose, and I thought if maybe only I could go over there, wherever it was, Wyoming or somewhere, that I could grow up in a different environment.

**Wilkins:**

And everybody would be working very positively and making progress.

**Bohm:**

Well, also being friendly and not fighting and sort of having meaning and so on, you see. I had the distinct feeling that I'd grown up in an environment which was not good for me, which made me somewhat unhealthy both mentally and physically — that I wasn't really getting the right physical background.

**Wilkins:**

So you did feel that you were sort of nervous and anxious.



**Bohm:**

Anxious and sometimes bad-tempered and so on.

**Wilkins:**

Yes. So you felt that these great stresses that you'd been subjected to in this environment had taken their toll on you mentally to some extent?

**Bohm:**

Yes. And I pictured another environment where this wouldn't happen. And from there I went on to say that this is probably true of everybody. Gradually this idea dawned on me.

**Wilkins:**

Yes, well most people aren't capable of observing this in themselves. I mean, they may have all kinds of damage done to them psychologically, but apart from possibly feeling rather miserable, they generally lack the capacity of being able to look at themselves, whereas you seem to have been able to look at yourself in this situation.

**Bohm:**

Sometimes anyway. You know, in certain cases.

**Wilkins:**

At least in that respect you did. How old would you have been?

**Bohm:**

Well, that must have been very early because I remember I was at a house where I was in the first few years in school. I can remember that memory is associated with that image of that house you see.

**Wilkins:**

Why was it associated?

**Bohm:**

Well, I remember that I had it at the time that I was there.

**Wilkins:**

There was no special reason. It just happened.

**Bohm:**

No. I remember it couldn't have been much after starting school. It must have sufficient time to allow me to read about the West somewhere possibly.

**Wilkins:**

What would that be? Six? Eight? Or what?

**Bohm:**

Not later than eight.

**Wilkins:**

Yes, I see. It interests me because you see when I was six and seven I had a most dramatic experience because my very friendly elder sister, my only child was taken off into hospital and was more or less removed from my life completely. Yet my memories are of no clear memory of any great misery, but I can deduce in hindsight that I was miserable because I remember my parents going to see the school teachers and asking about me. And you see, I think this is quite a common thing in children. That their parents can be murdered and all sorts of dreadful things can happen. They can be intensely miserable

but they are not conscious of it in a proper sense. And they can't tell you.

**Bohm:**

They are not conscious enough to remember it, anyway. In the moment that it's happening they probably know it.

**Wilkins:**

Yes, but they won't possibly know the reason for it.

**Bohm:**

No, they certainly very seldom know the reason.

**Wilkins:**

They are more like to some extent animals. I mean, they experience it at one level without being fully conscious. But in your case you seem to have been able to figure it out, which was a term you used before. And I'm not suggesting that you were totally objective towards yourself. I mean, it would be ridiculous. You seem to have had an unusual capacity for being able to look at yourself. I mean, can you see any reason why you are? Was it simply

that the intensity of the problem was so great that you were sort of forced to consider yourself?

**Bohm:**

Well, maybe. The idea occurred to me, you know, that I could be happier somewhere else, in some other environment, you see, somehow.

**Wilkins:**

That would mean getting away from your home, for sure.

**Bohm:**

Yes, but I meant that I thought of some sort of this magical West which was so big a part of the American dream.

**Wilkins:**

Yes.

**Bohm:**

That way you'll see how it figures later, too. It comes in later.

**Wilkins:**

Yes.

**Bohm:**

I was tremendously impressed by this pioneer, this opening up of the West. The symbolism of it of the setting sun and so on, you see. One of the American coins was a half a dollar. It doesn't exist anymore. There was a sort of the sun setting on mountains with rays going out which was a common symbol, you see — the golden rays promising a brilliant future.

**Wilkins:**

I see, yes.

**Bohm:**

So that was a sort of feeling I got from the culture.

**Wilkins:**

This was the new world?

**Bohm:**

The new world, and the West was the newest part of the new world.

**Wilkins:**

Yes.

**Bohm:**

Europe was looked down on as old and decrepit and so on, caught in tradition.

**Wilkins:**

Yes, yes. I suppose this connects with the whole idea of new vistas in science, too.

**Bohm:**

Yes. Well, I think looking forward to something new and, you know, unlimited range of vistas, you see. Like, you know, I remember that there were some mountains I used to climb when I was in college in the middle of Pennsylvania and you could see one row of other mountains, you see, going on and on.

**Wilkins:**

How far away from your home was that?

**Bohm:**

About a hundred and something miles. 120 miles.

**Wilkins:**

How often could you get to the mountains?

**Bohm:**

Well, the mountains were right next to the college, you see.

**Wilkins:**

That's where you were at college?

**Bohm:**

Yes. We had some mountains at home, too, the smaller kind, and I used to go there quite often.

**Wilkins:**

Did you go with other boys?



**Bohm:**

Well, in the beginning yes, and later I went alone.

**Wilkins:**

Yes, yes. So really, this whole American dream of new horizons and so on fitted in this, you might say was an important stimulus in your whole approach to science and life involving new horizons.

**Bohm:**

Yes. See the point is that it seemed that California was really the ultimate of that; it is as far west as you could go and it was to have tremendous possibility in it.

**Wilkins:**

Yes, yes. And was that one of the reasons you did go to California?

**Bohm:**

Yes, I think it affected me.

**Wilkins:**

But when you'd finished at college, I mean did you have a choice of going to other places?

**Bohm:**

I could have gone to Rochester or some such place, you see, in New York. But I got a fellowship from the college itself of \$600.00 to go anywhere. Then I got a letter from Caltech saying that they would give me free tuition so I decided right away to go there. This golden dream, as it were, which was so much part of the American culture.

**Wilkins:**

Yes, one could also say of course that this whole idea of alternative ways of living and looking at things was stimulated by the disastrous domestic situation that you were in. There must have been immense pressure to think that if life was to have meaning at all there must have been some alternative to living in your home where you had this great sort of negative relationship between your father and mother.

**Bohm:**

Yes, and also the whole community was a bit depressed. You see, especially as the depression came. I began to feel it was very limited. For example, there was essentially no science going on there and very little of anything else. Wilkes-Barre was known as a good place to have come from.

**Wilkins:**

So it was depressed and very culturally deprived?

**Bohm:**

Yes.

**Wilkins:**

And full of poor whites?

**Bohm:**

Well, yes. In the earlier days it wasn't so bad, I didn't feel it so bad because there was still prosperity and the people were still looking forward to things.

**Wilkins:**

How old were you when the depression was going on?

**Bohm:**

Well, it started in 1929 and I was about 12 years old.

**Wilkins:**

Yes, so in your early teens you grew up on the middle of the Great Depression.

**Bohm:**

Yes.

**Wilkins:**

So, presumably that area was not possibly affected more than many areas in the United States. I mean, to make it really sort of dreary.

**Bohm:**

Well, it was. I don't know if it was worse, but it was pretty badly affected, you see.

## **Wilkins:**

I did remember one man telling me once that the depression wasn't too bad for him because he said, "But everyone sat around at home. We took it quietly. There wasn't much money but, you know, it was just sort of a quiet time. It wasn't so bad." But presumably in that community it was worse. There was real sort of poverty and starvation.

## **Bohm:**

Well, I don't know if there was actual — there may have been, you see. There was a lot of poverty but it was mainly the sense of hopelessness, that people couldn't hope to get jobs and what was the point of the whole thing. And some people may have suffered a great deal, but they were not visible. Some of the mines worked moderately steadily. It happened that my friend, this Polish fellow, his father was working moderately steadily. Different mines would have different situations and other industries failed and so on. Banks failed.

**Wilkins:**

But did you have any friends whose fathers became unemployed?

**Bohm:**

No, I didn't actually. But I was affected also by the whole general meaning of it. It was a sort of a shock that this would happen in America, that there had been such a forward look of progress and prosperity.

**Wilkins:**

Ah yes, the great dream of progress and now the bottom was falling out.

**Bohm:**

Yes. It sort of took away part of the meaning. And when Franklin D. Roosevelt was elected and began his new policies I became very enthusiastic about them.

**Wilkins:**

Yes, yes. And so this whole thing about the whatever it's called, American Dream, I don't know

what the correct expression is, this did have quite a big effect on your whole attitude towards life.

**Bohm:**

Yes, I mean this American Dream included, you know, freedom, equality, and justice. Also another feature was individualism. You see in the beginning I felt that each person must find his own way and it was the land of opportunity where each person could develop according to his capacities. Stood on his own feet and so on. Then I could see that with this depression it wasn't going to happen. A tremendous number of people were doomed not even to get a job and get some sort of very stupid job and very low pay. And banks would fail. People had saved up money and banks and other companies and stocks, whatever, and they could all vanish.

**Wilkins:**

So the American Dream certainly wasn't just a matter of people having a lot of opportunity to make a lot of money. It was also a dream of social justice.

**Bohm:**

Yes, and opportunity for the individual regardless of his background. This also appealed to me. I did not identify even with my immediate ancestors much less with those 2000 and 3000 years ago, the Jews. I felt that each person was an individual and could not be made responsible for his ancestors, you know, nor could he count on them. That he had to prove himself as an individual. Abinitio, from the beginning.

**Wilkins:**

So this whole American idea about the nature of a good society stimulated this sort of attitude in yourself, is that right?

**Bohm:**

Yes, in fact in the beginning I believed in all the conservative ideas about individualism, but then the depression made me begin to question those and saying that the society must have some responsibility to not only for the poor people but to give everybody a chance. You can't just leave it to the law of the jungle.



**Wilkins:**

You mean laissez-faire wasn't ?

**Bohm:**

Yes, I believed in it in the beginning but later I questioned it.

**Wilkins:**

Yes, yes. Well anyway, the whole sort of theory about the American society did make a big impression on you in your early years.

**Bohm:**

Yes. I felt America would essentially express the highest possible, highest human achievements which up to date, you see.

**Wilkins:**

Yes, I think a lot of European people don't give the American society credit for this progressive element in it which was, after all, derived from the Enlightenment and the French Revolution, wasn't it?

**Bohm:**

Um hmm [agreement].

**Wilkins:**

In fact, didn't the American Revolution take place before the French Revolution?

**Bohm:**

Yes, but the principles had a common source.

**Wilkins:**

Yes, exactly. And I think that this is also where the people in Russia ought to recognize a bit more that the United States is not just sort of President Reagan's era. They shouldn't look at the whole thing 100% negatively because it does have some very good aspects to it. But, there seems to be one can see various factors which one could argue that sort of stimulated you into this new sort of vista exploration and insights and other areas and also the questioning of accepted ideas — some degree of objectivity to stand outside and question. Because you can't question if you don't?

**Bohm:**

But there was also a certain amount of idealism in the sense of the belief in the perfectibility of mankind.

**Wilkins:**

Yes. Why was it that you argued against the other people that human beings might be perfectible? Where did you get that?

**Bohm:**

No, I argued for that, that they are perfectible.

**Wilkins:**

Yes, why did you argue for perfectibility?

**Bohm:**

I felt that basically people were good and essentially bad things came because most people anyway the pressure had been too great or something. Unless the opportunities had been too small. That was part of the American idea that if everybody could only have his chance to do whatever he could then the good would come out.

## **Wilkins:**

Yes, you mean this is the Enlightenment idea, that people are basically good and for this good to be expressed you just need to have the right environment to do it.

## **Bohm:**

Yes, that was sort of the idea. It was rather a common idea in the background. Now, you see, but a lot of people had the other idea that there wasn't much you could do. When I was about 18, 17, the last year in high school, I used to have arguments with the father of a friend of mine. By then it was mostly Jewish boys I knew. He was a salesman, Mr. Weisent [?]. He would argue with me and he said, "You know that you have an unrealistic idea of people," and he said people will only work because of fear. He said either in America or in the West essentially they would be fighting about unemployment or something and then in Russia they would be fighting for their lives. One way or the other that was the only way to get them to work. He preferred the fear that comes from the lack of money rather than the fear that would come from the State.

So we used to argue about that and I said I wouldn't accept it and I didn't have a great opinion of Russia at the time. We'd heard a lot about what Stalin had been doing.

**Wilkins:**

Oh, well, that must have been 1938 or so.

**Bohm:**

Yes, well, before, in the 30's. Gradually this sort of information?

**Wilkins:**

When did this Stalin stuff start coming out much?

**Bohm:**

A little bit was coming out already in the 30's.

**Wilkins:**

It's getting a little bit cold. I'll put on one of these lamb coats.

**Bohm:**

A little bit was coming out in the 30s, but there wasn't enough to get any proof or anything. But things were pretty grim and miserable there.

**Wilkins:**

Yes, 1935. I'm trying to think of my first year in Cambridge as an undergraduate. Yes, all the Sherb [?] trials were beginning then, yes, and that was fairly late on.

**Bohm:**

Yes, and one could get the impression that the government was very oppressive in Russia, you see.

**Wilkins:**

Yes, well I suppose the whole collectivization and so on was much earlier, wasn't it?

**Bohm:**

Yes. So, I didn't really have a great regard for them, but I was very interested in politics all around. I remember just about '32 or so — maybe it was later, it must have been later — Mussolini came out with

what I regarded as an outrageous statement that war is the help of nations and there were a lot of other equally stupid things he said in there. I remember I got very upset about it. I remember I wrote a — the first year in college I think I wrote a theme on that arguing against for the English composition class.

**Wilkins:**

You mean at college there were English competitions?

**Bohm:**

Compositions.

**Wilkins:**

Oh, compositions?

**Bohm:**

Yes.

**Wilkins:**

What age were you then?

**Bohm:**

Well, I must have been 18 when I first took?

**Wilkins:**

18. But you mean this is after you'd finished at your school.

**Bohm:**

High School

**Wilkins:**

High school, and you'd gone to college. You mean that it wasn't just science alone, it had?

**Bohm:**

Well, you had composition, literature and a few other things. Of course languages, and in the last year you could take philosophy or sociology or something like that.

**Wilkins:**

Really? Well what proportion of your — how many years were you at college?



**Bohm:**

Four years.

**Wilkins:**

And what proportion of your time was on science?

**Bohm:**

The major proportion was science and mathematics, yes.

**Wilkins:**

I see, but there was quite a bit of broader education as well.

**Bohm:**

Yes.

**Wilkins:**

Compares very favorably with universities in this country now where you get, you can go two or three years without getting anything whatsoever of that nature. Science, mathematics, and nothing else.

**Bohm:**

Yes, well we had science, English composition, literature, philosophy, and a few other things, humanities.

**Wilkins:**

They ought to do a bit more broadening like that in this country, too. Anyway in this thing you were arguing, I forgot what.

**Bohm:**

Well, arguing against Mussolini's thesis about war and? But then you see that was probably when I was in high school when he said it but it may have struck me so much that I remembered it for years. But a little bit later my father came out in favor of Mussolini. He had a friend, an Italian friend, a businessman who convinced him that Mussolini was doing great things, making the trains run on time and bringing order into Italy. I thought this was nonsense, that it was just a clown really and sure that all this order was just a show, that there was nothing behind it.

**Wilkins:**

Yes, I don't know how true that is because after all Hitler got some sort of order into Germany.

**Bohm:**

I know, but Hitler was another story. The first thing was Mussolini and a lot of people, these businessmen, began to admire Mussolini, including my father. In fact Mr. Weiss also admired Mussolini, this friend of my father, a friend of mine. You know we used to have talks about him and we were quite friendly, but you know I felt I didn't think much of him at all. But when Hitler came on the scene then this was much worse. You see I could see that he meant business and that he was really dangerous. He was attacking the very foundations of civilization I felt.

**Wilkins:**

Now wasn't Mussolini was that, too?

**Bohm:**

But he was very ineffectual.

**Wilkins:**

Torturing and imprisoning trade unionists, left wingers, and all sorts.

**Bohm:**

But that was comparatively ineffectual and it wasn't directed at the very roots of the thing. You see, with Hitler he would, Mussolini did praise irrationally and all that. I didn't. I was very much against it, but I think Hitler just simply said blood is what counts not truth, not thought, not anything. None of the values of culture counted, you see. Race and blood and all these irrational things. And I think with the German ability to organize I thought it was dangerous, you see. My father had always been a great admirer of the Germans for their orderliness and cleanliness and so on. I had said they were very fine virtues but I felt always a little uneasy about them. I felt really — and when Hitler came along there must be something very wrong with all this virtue.

**Wilkins:**

You did once tell me which precisely, which part of Europe your family?

**Bohm:**

From Czechoslovakia. It was a place called Munkache [?]. It was really Hungary at the time. It later became part of Czechoslovakia.

**Wilkins:**

And why did, you say your father went over there on his own.

**Bohm:**

No, he came from there and he went to America on his own.

**Wilkins:**

Came from Europe to America, yes. And he then met your mother.

**Bohm:**

At my grandfather's house, right.

**Wilkins:**

Yes. Now let me see, he, was he sent to your grandfather's house?

**Bohm:**

No, he was just given the name. That was the custom.

**Wilkins:**

I see, give him the name, yes. So, your mother's family came from the same area?

**Bohm:**

No, she came from Lithuanian, their family.

**Wilkins:**

How did they get the name then?

**Bohm:**

Well, the Jewish organized; the Jews had a sort of a vague informal organization to sort of help the immigration to America.

**Wilkins:**

I see.

**Bohm:**

I don't know how they did it. It was sort of a grapevine.

**Wilkins:**

Yes, and so somehow they link people. You don't know on what basis it was?

**Bohm:**

No. I don't know how they managed it, but they did.

**Wilkins:**

Can you remind me why your father left Czechoslovakia?

**Bohm:**

His parents had died at the age of 12. He was an orphan.

**Wilkins:**

Ah, yes.

**Bohm:**

There was nothing for him.

**Wilkins:**

You said that. They had died and he had no one really, no family.

**Bohm:**

No.

**Wilkins:**

But were the Jews fairly poor in that region? Was there economic deprivation?

**Bohm:**

There were some who had quite a bit of money and some who were not so well off you see. But there was some sort of community spirit. It was a very strong community spirit, religious, such that they did help those who were poorer, so my father had places



to stay until he was 15 and then they probably helped him to immigrate.

**Wilkins:**

Yes, their idea was here's this orphan and the best way to solve his problems is to send him off to the land of opportunity.

**Bohm:**

Yes. And then later on he called for his brother who already was married and had some children.

**Wilkins:**

Oh, I see. They came afterwards.

**Bohm:**

Yes.

**Wilkins:**

That wasn't the brother you rather admired? The uncle?

**Bohm:**

No, no, that was somebody else. That was my grandmother's side on my mother's side.

**Wilkins:**

On your mother's side, yes. I take it it wasn't so much a question of a lot of people having to move out of Europe because there was great general poverty. I mean, the Irish, for example, moved to the United States because there was dreadful poverty all around.

**Bohm:**

You see if you take — I don't think poverty was so great in Hungary, the poverty was really greater if you went to Poland, Lithuania, and Russia.

**Wilkins:**

I see.

**Bohm:**

Many of the Jews came from there, very poor. If you say from Germany, Hungary or Austria it was not quite so bad.

**Wilkins:**

Yes, yes. I wonder to what extent the development of science in the United States was connected with this sort of American social philosophy as you might call it? I don't know that in general there was very much evidence of it.

**Bohm:**

No there wasn't much evidence. No, in fact I was rather on a limb by myself.

**Wilkins:**

Yes, I think the American's did very well in engineering things, didn't they?

**Bohm:**

Um hmm, yes.

**Wilkins:**

But I thought a lot of universities were set up in relation to agriculture and other sorts of practical needs, weren't they?

**Bohm:**

Yes.

**Wilkins:**

So the whole scientific technological development in the United States, a lot of it was on the basis of the needs for applied science.

**Bohm:**

Yes, there was a very heavy emphasis on that.

**Wilkins:**

Yes. It may have been a bit different in the East, I don't know.

**Bohm:**

Well, all the state universities started that way and a great many of the others.

**Wilkins:**

Did they?

**Bohm:**

Yes.

**Wilkins:**

And their real sort of basic fundamental science more people call knowledge for its own sake, this was possibly more stimulated by the people coming over from Europe, for example, out of Germany with Hitler. I mean, that was rather a mess.

**Bohm:**

That made a big push, yes. There had been centers like Princeton and Harvard and Yale on the East Coast, but these were special places where only rather wealthy people could go there.

**Wilkins:**

Yes. They weren't typical of the American universities as a whole.

**Bohm:**

No.

**Wilkins:**

In fact, I suppose this whole thing about brain drain from Europe has never stopped post-war. It was

Hitler and after the war it was more money jobs in science wasn't it.

**Bohm:**

Yes.

**Wilkins:**

And it continues to be so. So the center of gravity of science in the world today is very much over there isn't it.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

So that you're being activated by this, these ideas were somewhat non-typical?

**Bohm:**

No. You see I was really activated by the state of the political situation, especially this rise of Hitler and the danger of war which greatly took a lot of my attention.

**Wilkins:**

Why were you against war?

**Bohm:**

Well, I didn't want the war. It was dangerous. I mean, I thought war was a destructive thing. But with Hitler there would be danger of war, you see.

**Wilkins:**

That he would start war.

**Bohm:**

Yes. He was oppressing not only the Jews but also some other people and destroying — I felt much more significant — the very values in which civilization is founded.

**Wilkins:**

But your being connected with the Jewish community, presumably your Jewish community was somehow aware of the dangers of the Jews in Germany.

**Bohm:**

We were aware of it but they tended to minimize it.  
You see, they didn't?

**Wilkins:**

They hadn't met any refugees.

**Bohm:**

Well, there were a few, but they were helping a few refugees. But the problem didn't, in the beginning at least, didn't take the?

**Wilkins:**

Yes, it didn't take in properly.

**Bohm:**

They didn't take it in, yes. There was a sort of a saying in Europe, like an old, they used to use these old sayings in Europe like the soup is never drunk as hot as it's cooked, and so on.

**Wilkins:**

You mean it wasn't as bad as it sounded.



**Bohm:**

Yes. That's a lot of noise but when you come down to it it won't be quite that bad. That's the sort of attitude.

**Wilkins:**

Well, little did they know.

**Bohm:**

But I felt immediately it was worse than it sounded. You see, I felt that Hitler really was dangerous. I sort of felt Mussolini was a contemptible person but Hitler was really dangerous.

**Wilkins:**

Yes, it does sound as though you were able to figure out clearly at quite an early age the dangers of fascism.

**Bohm:**

I used to read some of the left wing, slightly left wing journals like the New Republic. It was a liberal, slightly left journal.

**Wilkins:**

Oh, I see. How did you get on to them?

**Bohm:**

Well, they were in the library.

**Wilkins:**

Public library?

**Bohm:**

Yes.

**Wilkins:**

The public library seemed to be damned useful to you wasn't it.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

I wonder how long it's actual to allow public libraries to go on.

**Bohm:**

I don't know. Of course she could just cut off the funds that she's doing.

**Wilkins:**

Do you realize if you ring up the telephone to find out the time now, to get the time signal, that it's now an advertisement for a watch company. That this is, yes the time, the Accurest [?] time, is 3:23. Accurest is the watch, so this is extraordinary. Everything is an advertisement.

**Bohm:**

Yes, value for money.

**Wilkins:**

Yes, so British telecom presumably gets fees for Accurest to pay them money for the privilege for advertising every time you ask for what the time is. But, so the public library was free?

**Bohm:**

Yes.

**Wilkins:**

And this is presumably part of the whole notion of American freedom.

**Bohm:**

Yes, and also their insistence on the value of education.

**Wilkins:**

I see, education, an improvement in progress. But it's interesting, you see, the Thatcher ideas in individual struggle, but the American thing accepted the fact that you must have state, free state systems for at least an education.

**Bohm:**

It's always taken for granted. You would have free state education, yes.

**Wilkins:**

I mean Thatcher wants to do away with this doesn't she?

**Bohm:**

Yes.

**Wilkins:**

She wants to have two [???]. But the health system never became free in any big way, did it?

**Bohm:**

No, no, it never did. But it was probably rather similar to what it was in Britain at that time, which wasn't really that good. You had to have money. The doctors would actually come if you had no money and many of them didn't charge very much.

**Wilkins:**

Yes, yes.

**Bohm:**

So it wasn't quite as bad as it might have sounded. But the hospitals, you had to pay for them. But there were city hospitals for people who couldn't pay, you see.

**Wilkins:**

Yes, so that the library system was really a very big help to you?

**Bohm:**

Yes, well there was really only one large public library, about a mile and half away, and I would go there.

**Wilkins:**

Was this a reference library?

**Bohm:**

No, it was a general library. It had a reading room and books and so on.

**Wilkins:**

So you got political magazines.

**Bohm:**

Scientific magazines, all sorts, books of various kinds, novels and science books.

**Wilkins:**

I mean if that place hadn't been there, you would have lost a very great deal in your life.

**Bohm:**

Yes.

**Wilkins:**

Because you were not living in a cultured community where you would have had access to political magazines and scientific magazines in other ways, would you?

**Bohm:**

No.

**Wilkins:**

Yes, it's quite impressive, that.

**Bohm:**

Well anyway it was constant harping on the dangers of fascism in these journals, which I took seriously.

**Wilkins:**

That was a small minority in the United States but it was articulate.

**Bohm:**

Yes, and then there was a fellow call Father Coughlin, who was a sort of a fascist who had a considerable following, and he put out a journal called Social Justice which I used to read just to see what they were doing.

**Wilkins:**

He was American?

**Bohm:**

Yes. You see, the typical sort of thing was people would write letters to it saying you know the church says we should walk behind Christ. I don't agree with that. I think we should go ahead of him with a club and clear the way.

**Wilkins:**

That's what the fascists would say?



**Bohm:**

Well, that's what this fellow that wrote a letter to the journal said. That was the kind of thinking that they had.

**Wilkins:**

I see, there was a sort of onward Christian soldier as you club down the people and clear the way for Christ.

**Bohm:**

Yes. But I used to read the fascist journals where I could read them and so on just so I could keep up with what they were doing. I use to read almost anything, you see.

**Wilkins:**

Did you read fairly fast?

**Bohm:**

Yes.

**Wilkins:**

It's very interesting how this contrasts with say my children. Most of my children read very little. I mean, and some of them hardly ever read books and yet I think they're quite as intelligent as most good university students who can read books. It's just they haven't gotten into the habit or acquired this way of living in which books are an important part of life. And, I mean, does it have something to do with a sort of deprivation in other directions that one seeks? You know, ideas and so on off the printed page somehow that?

**Bohm:**

Well, you could say that everyone tries to live in imagination and so on and ideas because the realities are rather grim and limited.

**Wilkins:**

Yes, because there is not much alternative. If you see what my children do is they have television and they have all kinds of music and they can go — you know young people's music, bands, and things, and they have all sorts of other media in which they

work through and social life and everything. It may seem that some of this is superficial, but this doesn't leave them with much feeling of?

**Bohm:**

You know, in the schools or anywhere where it was mentioned and I more or less accepted that when I was a child.

**Wilkins:**

Yes, it had no individual freedom you mean.

**Bohm:**

Yes, that's right. People would say that's the next thing to being an anarchist, which was really impossible.

**Wilkins:**

We didn't know what anarchists were, of course.

**Bohm:**

No, we thought they were crazy wild people.

**Wilkins:**

Yes.

**Bohm:**

There was this one black girl when I was in the eighth grade, and one day she got up and, I don't know on what occasion, but she started to tell about socialism. It seemed she was talking rather compulsively about socialism. I can't even remember what she said, but you know, everyone else was against it. That's all I can remember. All the working people were against it.

**Wilkins:**

But did you feel somewhat interested?

**Bohm:**

Well, I didn't know at the time because she was talking in a rather mechanical compulsive way, so it didn't grab me.

**Wilkins:**

Yes, you mean this was some strange idea that you just noticed the other people objected to.

**Bohm:**

Yes, and she wasn't presenting it very well.

**Wilkins:**

Very well, yes.

**Bohm:**

But I think I got a somewhat more favorable presentation in journals like in the New Republic and The Nation. It wasn't that they favored it, but at least you could look at it more favorably, and I used to argue with Mr. Weiss saying perhaps socialism should be given a chance.

**Wilkins:**

Was that the rabbi?

**Bohm:**

No, the other fellow. The friend of, the father of my friend. And he said, "No, there is not the slightest chance that it would work."

**Wilkins:**

Oh, he was the one who, no he wasn't the one who liked the Italian fascist?

**Bohm:**

No, that's my father. Well, he also liked it too, yes. But he used to argue that there was only fear that would drive people, and I argued against that.

**Wilkins:**

Socialism appeals to higher things in human beings.

**Bohm:**

No, he said it was a beautiful dream, but quite impossible.

**Wilkins:**

Yes, yes.

**Bohm:**

I think that he was at least trained to be fair, but other people would say it's a terrible thing.

**Wilkins:**

Well, I suppose that Mussolini and the war was a little bit like this whole thing about having to fight and prove yourself.

**Bohm:**

Well, machismo, you know, being strong and?

**Wilkins:**

Yes, and you had quite a belly full of that already. You were in a mining community.

**Bohm:**

It seemed already it was a pretty — well this fellow, this carried immensely further into the realm of nonsense than anybody I'd ever seen. Because I'd actually never seen anybody who had ever said war is good.

**Wilkins:**

Yes. Did you happen to see the television program made by two Americans about fascism about a week ago?

**Bohm:**

No.

**Wilkins:**

It was quite interesting. It was all documentaries and apparently it got very little attention at all. It was a commercial flop in the United States. People just weren't interested. They didn't want to hear anything about it.

**Bohm:**

Um hmm [agreement].

**Wilkins:**

It was the whole rise of fascism and Nazism right up to the time of World War II. It was quite educational but there was such a feeling of isolationism there and just wanting to, you know, it's nothing to do with us. That's the philosophy.

**Bohm:**

Yes. Well that was the sort of thing people wouldn't worry about it. But I felt that quite a few, I gathered from the New Republic that quite a few of the



wealthier people were in favor of it. Sort of viciously.

**Wilkins:**

Yes, you mean it kept the unruly elements that would disturb society.

**Bohm:**

And also it would be a counter to Russia.

**Wilkins:**

Yes, against communism.

**Bohm:**

Yes. Anyway the thing used to worry me.

**Wilkins:**

The rise of fascism?

**Bohm:**

Especially?

**Wilkins:**

And war.

**Bohm:**

People began around '37, some people, to expect war. Even when the war started in '39 I think people in America thought we could keep out.

**Wilkins:**

Yes. Yes, it wasn't their business. You still got that spirit with the bombing of Libya. It's a long way off. You can drop bombs on them and still nothing will happen to you. People in the States — unreality about the nature of the world. So you were right into political thinking.

**Bohm:**

I was still basically — I thought the democracy would be the only thing to improve things to say that the people should sort of raise their level and work together and serve along the lines of Roosevelt.

**Wilkins:**

Yes, yes. If this is an intellectual autobiography presumably the main emphasis would be on the science, but on the other hand your scientific ideas are related to your social thinking so in a way none

of this is separate. I suppose pursuing more fully the development of your political thinking is really part of the whole project. Is that right?

**Bohm:**

Yes, I think so, because I think that they're tied together. In fact my feeling was to say that science would also help the betterment of mankind politically by eliminating poverty and increasing rationality by creating a spirit of greater rationality.

**Wilkins:**

Yes, when you say greater rationality I can feel the great hollow laughter in the background.

**Bohm:**

Well, that's what I believed in at the time.

**Wilkins:**

Yes, quite, quite.

**Bohm:**

I think many people believed in it at the time.

**Wilkins:**

Yes, yes. And I suppose to some extent it's correct, isn't it, but one has to get a clear idea of just in what respect it's correct and other ways it's not.

Removing ignorance and superstition. How did you move then away from ideas of free enterprise, capitalism, more to socialist ideals?

**Bohm:**

Well, that was gradual in a sense. With the Depression came Franklin D. Roosevelt and the notion that you can't have this completely free enterprise. It won't work.

**Wilkins:**

Ah, yes. So this was a state enterprise providing jobs?

**Bohm:**

Well, not only that but priming the pump and getting things going, building dams and doing various other things.

**Wilkins:**

Yes, that was government money?

**Bohm:**

Yes.

**Wilkins:**

Taxpayer's money.

**Bohm:**

Yes. And the fact was if it hadn't come there would have been a collapse. Private enterprise — it seemed the experience showed that private enterprise couldn't organize itself.

**Wilkins:**

It couldn't work on its own?

**Bohm:**

It couldn't keep itself going in an orderly way.

**Wilkins:**

Yes. It needed some measure of Government intervention.

**Bohm:**

Yes, so probably at the beginning I thought it should be at the minimum, but then the appearance of fascism in Europe made this notion that wealthier people might favorite it here and elsewhere. It made me again doubt, they say that these people talked of freedom, but when it came down to it they were in favor of methods that were very much against freedom.

**Wilkins:**

You mean rich people like arms manufacturers in Europe?

**Bohm:**

Well, not only that but there were also people in America who used all sorts of forces against the strikers or who would pay the repressive legislators or favor various sorts of dictators who were repressive because that was in line with their interests. Not only in Europe but in South America.

**Wilkins:**

Yes, you mean you'd have a cheap labor force and security for people to keep wages down.

**Bohm:**

Yes, so it seemed that they talked about freedom but they were ready to use repressive measures in their own interests. They didn't really mean it, you see. They meant freedom to make money for themselves and not money for anybody else.

**Wilkins:**

Yes, that's not good. That just — freedom that she wants freedom for Tory right wingers to go into universities and talk and so not to be shouted down by students but then she — these are all quite glad if they have a great filibuster in the House of Commons and prevent some tam DLs [?] things coming up.

**Bohm:**

Yes, and I think also there were quite a few radical students when I was at college. I wasn't among them but they used to put out things in the paper, in the

college paper, criticizing William Randolph Hurst and things like that and it sort of affected me. The general atmosphere was somewhat critical of the whole situation.

**Wilkins:**

I see. So there were radical students at college but you didn't really associate with them.

**Bohm:**

No.

**Wilkins:**

Well, isn't that a little bit odd in view of the fact that you had been reading up on these ideas on your own in public library earlier?

**Bohm:**

Well, I didn't really think that they were — I mean I can't remember, but I didn't think they were really going to address the real problem. Some of them I felt were excessively in favor of what was going on in Soviet Russia, overlooking all these bad things. Some of them seemed, well, too contentious you see. So I wasn't terribly impressed by them.



**Wilkins:**

Were they a fairly small minority?

**Bohm:**

Yes, rather small minority.

**Wilkins:**

So it was rather quite a small number of these people and they gave you a general impression of being a few sort of rather useless sort of extremist oddballs.

**Bohm:**

Well, I don't know if it's exactly that but I didn't think that they really had a realistic grasp of the situation.

**Wilkins:**

Yes.

**Bohm:**

Nor did they — they were too dogmatic and too —?

**Wilkins:**

Yes, I think that the idea that they didn't represent anything very meaningful, you might say. I think this is very much in contrast with the same period, say in European university like Cambridge where you had quite a big proportion of students, including many of the most intelligent ones, who were sort of generally socialist and Marxist and so on. So you had really good minds sort of chewing these ideas over, and so obviously this would be attractive to other students because one could see quite a large number of people exploring these ideas in an intelligent way, as you had a small minority there.

**Bohm:**

Yes.

**Wilkins:**

And not that you felt exploring ideas very intelligently.

**Bohm:**

No. I still had faith that the American democracy or democracy in Europe would eventually confront

these problems and do something about them like the Depression and Fascism and Nazism.

**Wilkins:**

When and to what extent did you move further towards socialist or Marxist thinking?

**Bohm:**

Well, that came quite a bit later. I think we're sort of jumping too far ahead. That came when I got to Berkeley.

**Wilkins:**

That was after Caltech.

**Bohm:**

Yes.

**Wilkins:**

I see, quite a bit later. So your own political thinking was a bit on one side during your college days.

**Bohm:**

Yes. My main interest was really physics you see. Although I had a vivid interest in politics and the general state of civilization.

**Wilkins:**

So the presence of these radical students really wasn't much use to you.

**Bohm:**

No. I think that there were three, several things. One was the basic interest in physics and second was this question of politics, which served a lot of my — which I felt passionate about at times. Then came probably, I used to feel the need to get out into nature, into the mountains and walk, that the city was a bit wearing and depressing.

**Wilkins:**

Was it a very dull town?

**Bohm:**

Well, it was not only that, but I remember we used to go camping sometimes when I was in high school

and after a few weeks I felt extremely healthy and everything right. And as soon as I got back into the city I felt it was all going — sort of general something wrong, the whole life chaos, confusion. People had that idea that city life was not that all good.

**Wilkins:**

Not a feeling of wellbeing?

**Bohm:**

Not a feeling, no.

**Wilkins:**

Wellbeing physically and mentally.

**Bohm:**

Yes. There was a lot of friction in the city, subtle friction — the ugliness and the general noise and so on.

**Wilkins:**

So you got nature and life were somehow refreshing and meaningful.

**Bohm:**

Yes. Well it seemed cities had very little meaning. The larger the city the less meaning it had, you see.

**Wilkins:**

So they tended to represent the rather meaningless side of human life?

**Bohm:**

Yes.

**Wilkins:**

Whereas theoretically I suppose a city could be a great center for human beings to come together to build up all sorts of meaning. But those cities did not.

**Bohm:**

No, they had very little meaning in them. As far as science was concerned I began, because of this general situation in the family as you were saying, and because the whole situation was so grim all around — not only the city was poor, poor environment, but also the Depression. So I turned

more and more towards science, and I don't know if I put it on the other tape, but I thought of making inventions.

**Wilkins:**

Yes, you did. The idea of making money. That was one idea. If you had enough money then you wouldn't have to worry about doing science, you'd just be able to do it because you'd have the economic power to do it.

**Bohm:**

Yes. That was one idea. But then gradually I became more interested in the theoretical side of science as we went on.

**Wilkins:**

Inventions were rather a means to an end rather than an end in themselves.

**Bohm:**

Yes. So there was the focusing more on the theoretical side. I think it was in the 10th grade that we got?

**Wilkins:**

What age would that be?

**Bohm:**

That would be 16 thereabouts. I had geometry. Or was it 11th grade? Yes, geometry, that impressed me. That impressed me very much, the notion of proving these things.

**Wilkins:**

Yes, you mentioned this on the other tape. Could you expand a bit on this? Why did it impress you?

**Bohm:**

I can't quite say, but it seemed to be a very important achievement. Instead of just saying — previously I would think you're just describing things as you've seen them. It could be that way, it could be another way, that's just the way it happened to be, right? But in geometry you say it's just got to be that way.



**Wilkins:**

You mean in a sense it was a kind of absolute knowledge.

**Bohm:**

Yes, necessity, you see. It was something that just has to be instead of something that may or may not be. I'd never heard of such knowledge before.

**Wilkins:**

Yes. So all the ordinary hue in life is in a state of flux and change and decay and growth and everything and here you have something Euclidean, in particular. I mean, here was some sort of absolute thing that sort of stood there rock hard.

**Bohm:**

I don't know if I thought of it as hard but just simply that it just has to be that way.

**Wilkins:**

No, quite. Just that it had an absolute firmness about it which was in contrast to everything else.

**Bohm:**

Yes. Everything else was moveable in place and vague.

**Wilkins:**

Well, I suppose that this is — one can see that this could be an extraordinary thought because here was something you could really hold on to in life. I suppose some people it's religious conversion if they were convinced of the existence of God or something they might have a similar feeling. Well the first time here is something which is quite above the ordinary flux of human existence.

**Bohm:**

Yes. It's in a kind of truth or whatever. I never even put it into words, but that was the feeling.

**Wilkins:**

Yes, that was the sort of feeling there. Yes.

**Bohm:**

So I used to like algebra. We had that first in the seventh grade, but that was more a matter of

manipulation. That wasn't a matter of some special truth. But this idea of letting "x" standing for anything impressed me, too. To be able to reason about something that you didn't know what it was and then find out what it was by reasoning by first postulating "x" and then reasoning about it and then finding it out.

**Wilkins:**

Yes, you mean you can think about something without knowing what the thing is.

**Bohm:**

And through that thinking you get to know something about what it is.

**Wilkins:**

Yes, yes.

**Bohm:**

I used to like that, but geometry impressed me far more.

**Wilkins:**

But I suppose, of course, looking at mathematics of the modern standpoint you would realize that all this thing about the absolute truth is got much less basis as people used to think it had.

**Bohm:**

Yes, it's not as necessary as it looks. At that time I looked at it that way and then finally you're in high school and we had solid geometry. So at that time they decided to generalize and I worked out of a notebook a four dimensional geometry. There were various theorems.

**Wilkins:**

Where did you hear about a fourth dimension?

**Bohm:**

Well, it had been common knowledge. People had talked about it in science fiction all the time. It may have been part of my language for many years.

**Wilkins:**

You mean some of this was coming out from Einstein?

**Bohm:**

From Einstein and also from people writing science fiction stories.

**Wilkins:**

Yes, but they got it from Einstein.

**Bohm:**

Well, also possibly from mathematics. Just simply people said there could be a fourth dimension.

**Wilkins:**

Quite apart from Einstein in mathematics the idea of many more than three dimensions was standard.

**Bohm:**

Yes. For example, there was once I was in the library. We used to have — my father was getting worried about my lack of social life because I only saw one of these two boys, one boy or two boys, and

we'd talk about physics and science. He said he must go to the YMHA, the Young Man's Hebrew Association. There you can meet people. So I went there and I joined a club called the Orioles and all they did was to have business meetings to discuss finances and their basketball game, which I didn't have much to do with because I didn't play basketball very well. I found it very boring. There was one fellow who sort of was the older fellow in the club who sort of ran it. He met me in the library one day reading some science book and he said, "What are you reading that stuff for?" He gave me a sports magazine and he said this is what you are to read. So I opened it up and I found a story on the fourth dimension about a boy who threw a ball into the fourth dimension and it came back inside out.

**Wilkins:**

[laughter] That must have been quite an exciting idea. Did you see if you wanted to go into the fourth dimension and come back inside out? Maybe you felt you might have been better if you'd been inside out?

**Bohm:**

Well, I hadn't thought that, but it was quite an interesting idea.

**Wilkins:**

Well, I wonder if you subconsciously might have felt this idea that the — that if you felt you'd been a bit miss, ill-done by the whole environment by your home, you might have felt that you'd get off to California and life would be better. You might also have thought that if you'd got into some other dimensions you could be transformed into another person.

**Bohm:**

Well, I think the thought was like another planet they might do better. We might find beings or societies where things were better. That thought was often in my mind.

**Wilkins:**

You do seem to have this whole idea about moving out of our present plane into some other one where

life would be better and human beings would be better.

**Bohm:**

Yes, or else other beings that would be there would be better.

**Wilkins:**

Yes, quite, quite. Obviously one can never know to what extent home environment contributes to this sort of thing, but it might have been like that.

**Bohm:**

In general it seems science opened up possibilities of things that were more interesting and better and not so limited and so on.

**Wilkins:**

Yes, not so limited, yes. All the new vistas.

**Bohm:**

Yes, like opening up into the fourth dimension. One thinking of the model of the world which was four dimensional, that everything in this three dimensional world was a tube in the fourth



dimension. In some way I said there were hidden connections in those tubes which would help explain the forces between things. I worked out some sort of theory there including the idea that electrons would have tides on them and when the tides had the same frequency as the frequency revolution around the nucleus then that would be the condition for a definite orbit.

**Wilkins:**

Were you in college then?

**Bohm:**

No, that was in the last year in school.

**Wilkins:**

Where did you learn about electron orbits?

**Bohm:**

In the library.

**Wilkins:**

So you were reading up about Bohr atoms?

**Bohm:**

Yes.

**Wilkins:**

This is really rather exceptional.

**Bohm:**

Well, I thought at the time that I would write this whole thing up and send it to Einstein, but I never did. I thought finally he wouldn't particularly want to receive this thing from somebody he didn't know. A long manuscript.

**Wilkins:**

Were you able to write it up anyway to your satisfaction?

**Bohm:**

Well, I don't know. There are various things that didn't quite work out and so on.

**Wilkins:**

You never kept any of this writing?

**Bohm:**

A little bit was kept. My brother and somebody else have it now. I don't know where it is precisely.

**Wilkins:**

Well, I suggest it would be a good idea to try and trace it. I think that I certainly always say to my children when they are clearing out their rooms, I say don't throw out all your papers. If you've got a lot of school stuff at least keep one example out of several dozen things because I think later in your life you'll be glad. You can't keep it all but keep a specimen of this and that.

**Bohm:**

Well, I may be able to locate it.

**Wilkins:**

I think it would add to an interest of a book quite a lot. Were there any diagrams in it?

**Bohm:**

Probably.

**Wilkins:**

Well, you know, this I think — and if you started thinking about this whole idea again you might find it wasn't such a bad idea. In fact, do you think there is any possibility if you went back to thinking about this particular notion that it would be worth taking up again?

**Bohm:**

The tides you mean?

**Wilkins:**

I don't know, all these ideas that you had then.

**Bohm:**

I don't know. It's hard. They seemed a bit naïve.

**Wilkins:**

I see. On the whole you don't think so.

**Bohm:**

No. At the time it seemed a possibility. I began to think of making a theory of the universe or something.

**Wilkins:**

I think I can only vaguely understand this. You mean it's a little bit like these geometrical ideas of being on the surface of a sphere.

**Bohm:**

Yes. This wasn't exactly that, but it was the idea that we are sort of beings who stretch into the fourth dimension but our perceptions don't show either a cross-section or some sort of average. But this tied up also with my interests in?

**Wilkins:**

The tornado?

**Bohm:**

Yes, and motion creating being. I don't know how I got that. I couldn't have been very old at the time, but I read in the paper about tornadoes. I was probably interested in vortices already from watching them in the bathroom or somewhere else. And the idea was that there was some sort of being, a form, a constant form created by motion.

**Wilkins:**

Yes, you mean a tornado or a vortex is a little bit like a tennis ball. It moves about as an entity.

**Bohm:**

As if it was an entity but it isn't, you see.

**Wilkins:**

Yes, you mean what's in it is constantly changing.

**Bohm:**

Yes, it's only a state of motional fluid it's not an entity.

**Wilkins:**

Yes, but the state of motion sort of goes about.

**Bohm:**

It moves about stably. So I read it somewhere in the paper that tornadoes arose when there was a layer of cold air on top of very hot moist air so I tried to produce that by putting a container on top and a gas flame underneath.

**Wilkins:**

Yes, you got that on the other tape. Did you ever see any tornadoes?

**Bohm:**

Well, I never could see one. We had a cyclone once which was a kind of tornado, but I was in the house at the time and stayed there.

**Wilkins:**

You mean people were frightened?

**Bohm:**

Yes, well I wouldn't want to go out in there because you would have been killed. We had a store right next to — our store was next door and it took the window of the store. The boy who worked in the store said he saw the window coming in and almost reached him and then was sucked out again. Then there was a mill nearby with a tremendous cast iron top to a water tank. This was carried two blocks and landed on somebody's roof and destroyed that roof.

**Wilkins:**

I remember reading a story about how a man and his wife were sitting in their house having dinner and the whole floor went up with the table and chairs on it several hundred feet and then came down again while they were having their dinner. I mean, extraordinary things happened out there.

**Bohm:**

The cyclone probably is about 100 miles per hour. A tornado may go up to several hundred miles an hour.

**Wilkins:**

You know I feel that if you can fill in with a bit more specific detail on some of these things it's going to make these things very vivid. I think what you said about the boy next door and the window coming in and going out. I mean, the more sort of specific detail like this that you can recall. It's a bit like putting flesh on the skeleton. It brings the thing to life more because it does seem that if you lived through this quite terrifying experience, I suppose, of this hurricane?

**Bohm:**



Cyclone. It wasn't a general hurricane it was a cyclone they call it. It's a localized tornado.

**Wilkins:**

Okay, but this was quite terrifying, was it?

**Bohm:**

Well, it lasted about a few minutes. I was frightened but I don't think it reached the proportion of being terrified. We stayed in the house. It was clear we wouldn't move out. We just stayed where we were.

**Wilkins:**

At least, if you weren't terrified you must have found it a very impressive event. There was this great power outside that might destroy you and you had to stay in your house and not go out.

**Bohm:**

Yes, and before that time there had been a field where there was a tremendous number of blocks of stone that we used to like to jump across and it had apparently come from the mill that had been destroyed by a tornado. They had been strewn all over a vast field.

**Wilkins:**

Yes, I see, yes. So this idea about these great natural forces which would sometimes move around like, sort of destroying spirits or something. This was embedded in the whole folklore of the area. So when you made your — you started thinking about how these things worked, analyzing them in mathematical physical terms and making little experimental ones on the cooker you were in a way making a model of a volcano or something.

**Bohm:**

Yes, well, I was thinking more of an entity created out of movement. To say that out of nothing would come a being. Nothing but movement and energy.

**Wilkins:**

Yes.

**Bohm:**

This idea fascinated me. There were two things that fascinated me, movement creating being and light contacting things. That light was a sort of a finger reaching out contacting.

**Wilkins:**

Oh, just a minute. Let's take them one by one.  
Movement and being.

**Bohm:**

You see, remember my background which would tend to regard being as fixed and absolute, even if it was appealed to by geometry.

**Wilkins:**

You mean all the conventional Jewish society?

**Bohm:**

In general my attempt at security by saying I want to have a solid ground to move from one place to the next. To think of beings as just there, you see. And then beings engage in movement. But things are, and then from that they engage in movement. Is that clear what I mean? If you think of a person, you think here he is and then he moves.

**Wilkins:**

You mean is this partly the problem of change?

**Bohm:**

Yes. Change and constancy.

**Wilkins:**

And constancy, yes.

**Bohm:**

That idea used to — I couldn't have been more than about thirteen or fourteen when that idea began to take hold of me. I don't know how I got to it but my background was such to say that things were pretty constant and they changed. It was not a fundamental thing, which they moved from one place to another remaining more or less what they were.

**Wilkins:**

You mean that the fundamental problem was that if somebody, something stays still you mean it is, you comprehend that, that it's there.

**Bohm:**

I even understand if it's moving in a superficial way just changing it's position or its shape a bit.

**Wilkins:**

Yes, but the point was there was a philosophical difficulty as soon as you say that something which remains constant moves, there's immediately some sort of shaky ground. You mean how can it be the same ??? because it moved.

**Bohm:**

Well, I don't think I was thinking of that so much.

**Wilkins:**

No but you probably sensed it didn't you?

**Bohm:**

What I was thinking was actually the notion that movement is creation of things. I was saying in the beginning you begin to think things were there. Perhaps they were created by God or they were just always there, right? And then they move in a simple way from one place to another.

**Wilkins:**

Yes, you can sort of fudge this idea by saying oh yes it's just movement or something of the same thing. But you're kind of fudging isn't it?

**Bohm:**

Yes it is but I wasn't thinking of that at that time.

**Wilkins:**

I see, that wasn't the thing that was puzzling you.

**Bohm:**

No. What was puzzling me was that out of nothing would come a being. Out of nothing but movement.

**Wilkins:**

Yes.

**Bohm:**

Something creative. It was something rather exciting to think.

**Wilkins:**

You mean thinking about the tornado?

**Bohm:**

Yes. To think that out of movement was created a being, the tornado, which had great power.

**Wilkins:**

Yes, but that didn't relate at that stage to the general problem of being and movement.

**Bohm:**

Well, it was the problem of what is the origin of being. To say is movement primary, or is being primary?

**Wilkins:**

But, you're thinking about that in the context of the tornado.

**Bohm:**

Yes.

**Wilkins:**

So it was the tornado problem that made you think about this whole thing?

**Bohm:**

Or perhaps I wasn't even thinking of human beings, or perhaps I had in the back of my mind the tornado probably attracted my attention as saying here was a case where out of movement arose a being with great power, right?

**Wilkins:**

I suppose you might say you had a certain amount of tornado in your home, too, wouldn't you. [laughter] They did blow right through your home sometimes, didn't they? You read somewhere about this idea, the vortex, where they say movement is translated about and yet the material in the thing is changing all the time. That's right, isn't it?

**Bohm:**

Yes. I must have read about it somewhere.

**Wilkins:**

It isn't always changing.

**Bohm:**

As the vortex moves?



**Wilkins:**

No, because you've got smoke ring. I mean, the tobacco smoke is kept inside the thing. It's the same air, sometimes.

**Bohm:**

Sometimes, but in general the movement is transmitted.

**Wilkins:**

It could be, yes.

**Bohm:**

But it didn't matter. You see, the major point was that out of the patter of movement you have this being of the tornado. It was like creating a living being.

**Wilkins:**

Yes, yes. I suppose a little bit like an artist drawing a figure of a person or something, similar that the movement has created something. It isn't really because the movement stops then. Was this connected with the whole idea that matter itself is

essentially all electrons buzzing around in movement, too?

**Bohm:**

It was probably connected. Later it got connected with that. It's safe to say that atoms are particles buzzing around in movement.

**Wilkins:**

But you knew about the Bohr atom at that time.

**Bohm:**

No, I think I was only about 14 when I tried to do that experiment.

**Wilkins:**

So the tornado is before you knew about Bohr atoms.

**Bohm:**

Yes.

**Wilkins:**

As Eddington says, you mean the table isn't really there, it's all space and it's got these electrons all moving about or something. That sort of thinking about physics came later.

**Bohm:**

A little bit later, yes.

**Wilkins:**

So you had this general thing about being and movement and this was connected with this great natural force.

**Bohm:**

And also with this experience with having to cross the rock and being in a state of movement. In other words I connected it with my own being.

**Wilkins:**

I see, yes. You mean you were, you had to have a total sense of movement and not something which had indivisibility, that you couldn't really analyze it into bits.

**Bohm:**

Yes.

**Wilkins:**

Or it just wouldn't work.

**Bohm:**

Yes. Or saying that I myself was similarly a pattern of movement.

**Wilkins:**

Yes, I see. You would in a way go across the stepping stones like a tornado sort of moving.

**Bohm:**

Yes. And crossing those stepping stones I was in a state of being determined by the movement just as the tornado is.

**Wilkins:**

It's also related with the whole idea that we are never the — Heraclitus's thing about the river. That when from year to year we consist of all the different atoms, don't we?

**Bohm:**

Yes.

**Wilkins:**

And yet?

**Bohm:**

It's the constancy of movement pattern which makes our only identity.

**Wilkins:**

But there is also the form as well as the movement.

**Bohm:**

But it's the constancy of form and movement. The tornado has form only by virtue of movement.

**Wilkins:**

Yes.

**Bohm:**

You see the creation of form out of movement rather than imposing form on a static object.

**Wilkins:**

You get the same thing in the shape of cumulus clouds where you get a flat bottom to them and a cauliflower on the top don't you. You have a characteristic form which comes out of the movement of the air and you also get also get special forms like the — I think there is a spiral about sunflower out there where you get all these special forms that arise out of the movement of drugs. Whereas if you take a steam engine or a machine consisting of cog wheels and components together that's quite different, isn't it?

**Bohm:**

That's been imposed on it. The parts have been made separately by standing a form on the metal. And then they are put together. Here whatever is there, every form that is there arose out of the whole movement.

**Wilkins:**

The whole, yes, yes, whereas the mechanism is made out of components. Each of which had its origin on the lathe or the?

**Bohm:**

Was machine stamped or impressed.

**Wilkins:**

By some sort of process, yes. That's certainly true.

**Bohm:**

So it seems it was almost an organism.

**Wilkins:**

You mean the vortex is like an organism because it's got to be treated as a whole?

**Bohm:**

Yes, also because it's form arises in its movement. Just as we say that we are constantly the movement, the air food and water and so on as one maintains?

**Wilkins:**

Ah yes, in that sense it's flowing in and out, yes.

**Bohm:**

It's flow, call it flow rather than movement.

**Wilkins:**

Yes. I don't know to what extent your intense interest was simply a sort of philosophical scientific intellectual notion or to what extent it might have been connected with this violent, demonic force of these things knocking buildings down all around you. Presumably the two ideas both contributed to the interest. But you don't know how much, does one? But if you'd lived in an area where there weren't any tornadoes at all you might have been possibly rather less interested.

**Bohm:**

Well, I don't know. I mean, I read about the tornadoes. We didn't actually have full-fledged tornadoes in Pennsylvania but I read about them, that they were very destructive. That they would drive a straw through a board and so on.

**Wilkins:**

I suppose what you could say is that your real intellectual interest in it was given some extra force by the fact that you got of the things around. That at least would be reasonable, wouldn't it? It does seem



to me if you're writing this thing up it might be good to take that line so that you don't just have an account of all these intellectual notions in your mind but that these are linked up with your very down to earth physical life in the community. As you say, the boy next door who had this frightening thing and the window. Did the whole window frame and the glass move towards him and then move back?

**Bohm:**

Well, the glass — it was the store which had a large plate glass window. The plate glass broke off and came in. It was large. It was about as large as this whole area here.

**Wilkins:**

It came in as a whole sheet?

**Bohm:**

As a whole sheet. It almost reached him. It turned back and then it went out.

**Wilkins:**

Gosh. So it just broke around the edges so to speak. Out of the frame and the whole thing moved towards him and then retreated again.

**Bohm:**

Yes. It dropped on the street and smashed.

**Wilkins:**

Heavens. Intriguing phenomenon. [laughter] The threatening dance of the — it was like someone was going to punch you on the nose and when they just don't get close enough the fist goes away again.

**Bohm:**

He would have been killed if it would have gone a bit further.

**Wilkins:**

Yes, he was away you mean, from the danger from this.

**Bohm:**

And we were right in the next room.

**Wilkins:**

And you heard the glass smashing in the street?

**Bohm:**

We probably heard all sorts of noises.

**Wilkins:**

You mean there was a lot of noise?

**Bohm:**

The wind and so on, you know.

**Wilkins:**

Howling?

**Bohm:**

Well, it was shaking and howling.

**Wilkins:**

Were your parent's both there?

**Bohm:**

No, my mother was there. I don't know where my father was. He was somewhere else.

**Wilkins:**

What was your mother doing?

**Bohm:**

We were just sitting there against the wall.

**Wilkins:**

How do you mean? Huddled against the wall?

**Bohm:**

Just sitting?for example, the Buddhists often say suppose you try to look at yourself and find out what you are. You'll find all sorts of thoughts and feelings and characteristics that are always moving. And they depend on something else which is always moving and so on so that there is no static fixed ground for your being. Now on the other hand I think a great deal of our common language and concepts suggest you are sort of a fixed static being. That movement consists —

**Wilkins:**

Implies it.

**Bohm:**

Implies it. Movement consists of change from one state of being to another. The main point being, emphasis being on the states of being, the beginning and the end. This other view is to say movement is what you are. There is no fixed ground. That sort of interested me very much. That theme reoccurred quite often as I went further in my work later. Also it suggests another thing. That I was always relating what I was learning about nature to my own nature, you see. That I felt there was some analogy between them or something deeply similar or the same.

**Wilkins:**

You mean not simply that you were using yourself as your own laboratory so to speak, you were using as something more than that.

**Bohm:**

Yes, in the sense that I was in my nature I could sort of apprehend the nature of everything. It was not really a case of making an image of it or a concept of it, an abstract concept in which I mean. That theme also occurred later and also it helps to explain some

of my dissatisfaction with physicists, what they were doing later on, which we'll come to. They didn't seem to do that and didn't seem to see any point of doing it either.

**Wilkins:**

You mean in relating to themselves —

**Bohm:**

They weren't thinking that way at all. They were thinking they've got a formula that they could or a concept and they could make a prediction, you see. So they didn't even think it was of any point to an event.

**Wilkins:**

Yes, they were using it as a rather limited technical exercise.

**Bohm:**

Yes. Well that's what they meant by understanding, you see. So there was a kind of a difference between what I meant by understanding and what most physicists meant which gradually emerged. I think you can see that the beginnings of this were showing

here. The idea was that in some sense you could say that I had the not unspoken attitude, that I was a microcosm of nature or vice versa that I was somehow absorbing the essence of nature into my own being or that we were essentially the same. But understanding consisted of a kind of rapport of that kind rather than just merely a sort of an external correspondence of images and ideas and calculations.

**Wilkins:**

Yes, because all this business about things all being changing. I was talking, I went to talk a yoga biomedical trustees meeting over in Monroe. And I was talking to a young yoga woman coming back and she was emphasizing how the yoga whole philosophy is one of sort of ongoing change. Part of which is sort of built into nature as a whole, but also felt it's dependent on your own choices and so forth. Which is, of course, very interesting in relation to the whole business of aging and what one's attitude is towards that. However, I'm probably getting off the point there a bit. Could you explain a little bit more what you mean by you felt that you were somehow this, I mean you were some sort of, well

this isn't the right way to put it. I know that it may express it roughly that you had this sort of core in you which somehow reflected the whole nature of the universe.

**Bohm:**

Well, even more than reflected, but actually participated in it.

**Wilkins:**

Or expressed.

**Bohm:**

You see in the way, if you say a child is playing he says I'm a cowboy, I'm an Indian, I'm a tree or I'm a steam engine. He is in some sense in his being, obviously he isn't it at all but he's feeling in his being that that's what he is, right?

**Wilkins:**

Yes.



**Bohm:**

But in some sense he's experiencing and participating in the essential feature of that. He may not be so at all but that's the way he feels.

**Wilkins:**

Yes, well he's imagining it. Put it more crudely he's imagining it and he can't always distinguish very clearly between what is imagination and what is reality.

**Bohm:**

But imagination is more than a mirror image. It's a sense of the whole experience.

**Wilkins:**

Yes, you're not putting a sharp dividing line between imagination and reality.

**Bohm:**

I'm trying to say imagination is part of reality, but in fact it's essentially the creative source of reality. But out of this imagination which includes feeling and sort of will and all sorts of things emerges. The form

of things which the feeling for the form of things which may be unknown and that the imagination is not merely a reflection of what is there though. It can reflect what is there, but it can also go beyond what is there to show creatively to produce that were only potentialities.

**Wilkins:**

Yes, but if you were to take this idea of yours that each person is a sort of microcosm, then in a sense one is, it's like Plato's idea of all the ideas being there in you already.

**Bohm:**

Yes, well in some. But they are not there, the potential for the idea is there.

**Wilkins:**

Yes.

**Bohm:**

You see, it's not exactly even blatant that you have the capacity to be everything, the essence in some sense everything, you see. I think that that was the way probably was implicit in what I was doing. And

naturally you need information and so on as to how to direct this capacity. In other words so it will be relevant to any particular situation.

**Wilkins:**

Yes. I mean, you've gone sort of being and developing these sorts of connections with the rest of the universe unless you have some connection with it so to speak.

**Bohm:**

Yes, that's right.

**Wilkins:**

Or observing it in any context.

**Bohm:**

But there is a creative source of something beyond what is out there, that in some sense it's in you. Actually being the thing, experiencing things seemed crucial. For example, when I found some people who just simply worked satisfied out of a formula and calculated with it and I thought that the essence was gone or there'd be hardly any point. I might as well become the greatest furniture dealer in

Wilkesburg. You can always become very well known at that, right?

**Wilkins:**

Yes. It was I mean their attitude towards physics is presumably only one example of common attitudes to life generally. Most people are prepared just to jog along in certain conventional ways. I mean, as your father did to some extent with the conventional Jewish society.

**Bohm:**

Yes, he tried to have some; he tried to have something more and certain with his friends.

Anyway, that was one of the things that, you know, which I felt and I think the other thing that we were talking about was light. These powerful lights which I felt were reaching out like fingers, almost a subtle way that the light was subtly contacting everything that it reached. You know, that light was almost a form of contact, you see.

**Wilkins:**

Yes, you mean similar to the — was it Aristotle or someone who had the idea that rays went out from the eye to what was learned?

**Bohm:**

That's right. Yes. And though these rays were going out, the light going out and contacting the thing, and making contact back with us by reflection. So the idea of a very powerful light penetrating the darkness, which resisted this contact.

**Wilkins:**

Yes. You mean this light sort of symbolized the creative energy coming from the individual, sort of radiating out and making contact with the whole.

**Bohm:**

The whole, yes. I think those were some of the things. And I remember us saying at that time I was a sort of, felt the individual was the key thing. You see that is background was unimportant, all this other stuff. He had a certain worth, which he could bring out. And that if he had a chance, and the idea

that you were dependent on your ancestors or so that you could be responsible for what they did, or you know, seemed absurd at that time. That was partly this American feeling, too. All these people came from Europe; it didn't depend what they were in Europe and they had a new chance, right?

**Wilkins:**

Yes, they were pioneering a new world.

**Bohm:**

Yes, and they could just let all that stuff drop away. They might have been very poor people or very ignorant or whatever, but it didn't matter. Whereas in Europe, in a fixed society it would have mattered very much and they would have been almost condemned to go on with whatever they had been.

**Wilkins:**

Yes. But of course to make that clear separation again is a real mistake because you would say that you would say all this freedom is always a sort of related to the whole context in which you've come into that particular form of being at a given time. And your whole where you're going to go on is

whether the freedom is relating to the constraints in which you are operating isn't it.

**Bohm:**

Well, there were these constraints. But essentially I felt that it was very unfair that people were constrained according to who their parents were. And that somebody happened to have parent's with money or connections and he could go way ahead. Somebody else couldn't. It seemed that where he got to should depend on what he was intrinsically. That was my opinion at the time, you see. It was as sort of a view, which was common in the whole kind of environment, and read about it and so on. It seemed natural and just and fair.

**Wilkins:**

Yes, but you were able at that time to see that it would be a sort of mistaken over simplified model to think that anyone could have complete freedom and to break all links with their traditions and what they'd, these circumstances around them.

**Bohm:**

Well, it might be actually impossible. I felt in general that these traditions were holding people back, that they were sort of compelled to repeat things, which their ancestors had been doing.

**Wilkins:**

Yes, but on the other hand now would your view now be different from that in that you'd see more fully how that one is always dependent on the whole cultural situation? That one's freedom to create is a matter of some kind of dynamic interaction between this freedom probably and the condition it was given?

**Bohm:**

Yes, well it's clear that in the culture, at that time I pictured that the role of the society would have been to give people a scope for their freedom to do various things according their abilities and interest. Then I think gradually I began to see that the American society wasn't all that free, that a lot of this was only lip service to freedom.



**Wilkins:**

Yes. This was just a sort of sort of simple sort of political realization that the ideals were not lived up to in practice. But I mean would you say your general philosophical position now is different from the one you had then?

**Bohm:**

Well, it's different in some ways. In general my orientation is still to say that there's a background has been a very heavy burden in our people. That it forces people to keep on repeating nonsense that they have gotten stuck in.

**Wilkins:**

But wouldn't you agree now that this burden is just the other side? I mean strikes say suffering. I mean, in some ways the whole living is the transcending of suffering and so that you might also say that the whole creative living is transcending of the transforming of the burdens of society somehow, isn't it? One can never sort of say that these things are just totally negative can we?

**Bohm:**

Well, they may not be totally negative. I think the society or as it is now is efficiently chaotic and meaningless. That you have to be free inwardly of whatever restrictions are coming to the extent you can.

**Wilkins:**

Yes, but disregarding the particular nature of a society now where it's very easy to see all of these negative aspects, I mean all this is, as people would say, trivial or the mathematicians or something. I mean, the more profound question is don't you have to have a philosophical view, which can accommodate the fact that one is always living in a world of say just as one is always living in a world of suffering and also of joy? Then one is always living in a world of cultural convention and tradition and so on, but one cannot live without that.

**Bohm:**

Yes. Well you're bound to have it, but I think my general orientation has been that in so far as it's mechanical and unaware, which it mostly is. One of

the major points is to be aware of that and be free of it. A culture which is really vital and creative has been very rare, it might be possible.

**Wilkins:**

Yes, but I mean you're already discussing the differences between one culture and another. I'm discussing the other question that in it's essentially the individual can never ultimately be separated from the culture in some respects.

**Bohm:**

But in some respects he's got to be distinct from the culture. You see, in some respects he probably can't totally ever really separate from the culture, obviously.

**Wilkins:**

I think this is what I'm getting at. One has to accommodate this notion of the creative role of the individual. One has to build into this the acceptance of the fact that one can never divorce oneself from the culture, that one is always imbedded in it somehow.

**Bohm:**

Yes. We are imbedded in it somehow. You could distinguish between a fairly healthy culture and one that is not. Now if there ever were one you could say well such a culture would give us hope for people within that embedment [?] to move out and be creative and it wouldn't be such a rigid thing. On the other hand most cultures have some very rigid features which have really been destructive. It's also equally essential for people not to be caught in that.

**Wilkins:**

I don't whether possibly we're going to have too much of this off of the discussion here, which I don't know whether this is really the purpose of the recording. Maybe I'm at fault in sort of you pressing on this point, but I just wondered whether you had somewhat broadened your point of view.

**Bohm:**

I've said that it's the individual obviously starts from the general culture. He comes into the world and he picks up the general culture. That much is clear and that becomes a key part of his

individuality. Now then at a certain stage he may then begin to look at this general culture and discover all sorts of features in it, which are destructive and arbitrary and so on. Now to that in so far as he is still identified with that then it doesn't make any sense. I mean, you can't just go on and say everything about the culture is bad because obviously that would make no sense.

**Wilkins:**

I don't think I would even say that any particular aspect can be said to be just bad. I mean, all of this whole division into good and bad, I mean the things are really inseparable in some way, aren't they?

**Bohm:**

Well, you can't just point to an aspect and say it's bad, but you can say that there's a general tendency toward rigidity in this culture, in most cultures which is destructive.

**Wilkins:**

Yes. That is a perfectly? I quite agree. I quite agree that you can point out certain aspects of the culture which are negative which are sort of you might say

anti-life, anti-creation. I think my point was you've never really — Well, I'm really sort of grinding my own little ax here by saying that you've never really separate those aspects from the creative aspect. It's like good and evil. I mean, you can never really separate one from the other. Did I tell you about I had a dream? I don't want to go on about this here, but I had a remarkable dream some months ago. I think it was when I was ill. Of a net case of jewels, sort of oval of a net case. And I suddenly realized that the existence of evil was necessary for the existence of good and the existence of suffering was necessary for the existence of joy. Well, these tapes aren't just for me. Of course I was rather impressed by that dream. Anyway, let's get on with —

**Bohm:**

I mean, anyway, later on you'll see that we attempt to probe in this sort of socialist communist phase I sort of moved over toward the other side, but I was —

**Wilkins:**

What do you mean the other side?

**Bohm:**

Toward the collective side or the cultural side being primary. So I'm discussing now that phase which I had, roughly speaking, the most [???] with when I was in high school and possibly the early college years.

**Wilkins:**

Which was anticommunist.

**Bohm:**

Yes. It was anticommunist, anti-socialist. Brand much American individualism.

**Wilkins:**

Then you began to see the communist social ideas had a very important positive aspects.

**Bohm:**

Well, there was a slow movement by reading some of these journals, you know, [???] journals, to see that at least you could listen to the socialist ideas.

**Wilkins:**

And it had a positive aspect.

**Bohm:**

Then there were a tremendous number of aspects about our own situation that they pointed out, which I hadn't fully realized then. Basically it came to the idea that everybody, this individualism had no meaning if you had a situation where people had no opportunity. They were just stuck to be on clutter and poor jobs. And also if you had rich people whose only interest was to make more money for themselves and didn't care about anything else and became very powerful, it was clear that individuals had no meaning because a few people would take all the power and the other individuals would be crushed anyway, just as well as under in any other form of tyrannical government.

**Wilkins:**

Yes. Incidentally, can I divert for a second?

**Bohm:**

Yes.



**Wilkins:**

Did you see in the newspaper that the Baguan [?] or whatever his name was —

**Bohm:**

Yes I saw.

**Wilkins:**

That he had a bodyguard with guns and watch towers and everything.

**Bohm:**

Yes.

**Wilkins:**

He turned into a kind of Hitler.

**Bohm:**

Well, he started one minute —

**Wilkins:**

Power corrupts.

**Bohm:**

Yes. Anyway, it's hard to remember any more that's significant about the high school period. I mean, there was one thing about the high school period I wanted to tell you about. My attitude to dictators, you see I was very much against dictatorship of any kind. Months on the later years of high school in our English class we had to get up and make sort of a mock political speech.

**Wilkins:**

Make a what?

**Bohm:**

As if it were a political speech.

**Wilkins:**

This was an exercise in class?

**Bohm:**

An exercise, yes. Many people said they were running for president of the school or this or that. I got up and made a speech saying supporting my candidate for the dictator of the high school. And I

said, “Well, he was called Adolph Stalini.” I described his program and I said, “Stalini’s motto was, ‘Stalini Never Stalls.’” You see his very resolute character. And he said, “The Stalini Salute was to throw up your hands and empty your pockets of all valuables.” It was a long speech of that kind. But I think the essential part about it shows that I felt that the whole concept of dictatorship was wrong in that the —

**Wilkins:**

Either way it was send up of the whole thing.

**Bohm:**

That’s right, yes. Anyway, it was part of that feeling about — it was really part of this view of individual freedom and so on.

**Wilkins:**

How did this performance of yours go down with the [??] ?

**Bohm:**

The trouble is that I was a bit too stiff about it and I don’t think they — I wasn’t used to talking like that

and I don't think it went down as well it might have gone.

**Wilkins:**

The ideas were good, but you think that the actual way you put them across was —

**Bohm:**

Too stiff, it was too tense and I'd had no practice at all at doing that sort of thing. It was the first time.

**Wilkins:**

Well, presumably this is a real good idea to have these things and that also people could gain some experience. That's an interesting story. You say it was Adolph Stalini.

**Bohm:**

Yes.

**Wilkins:**

And you had to pull your pockets out —

**Bohm:**

You had to empty your pockets and throw up your hands.

**Wilkins:**

I see. Anything else you had to do?

**Bohm:**

Well I don't know. There were other things that I can't remember, but he had quite an extensive program which was noted for its absurdity.

**Wilkins:**

I think if you could think of a few more, if you maybe sort of dig up the memories I can get to the interest quite a lot. I mean, here you are a sort of celebrated quantum mechanics and you might say general philosophy sort of figure. I think if you can, in your intellectual autobiography you can give accounts of how you stood up in the classroom giving salutes and pulling your pockets out and with all of these ideas I think it would be quite interesting. I mean, I suppose to some extent well look, just think, you see, straight away. I mean, this

whole idea of emptying your pockets is so much like the Christian emerging [?] idea of emptying yourself of your conditioning.

**Bohm:**

Well, no. The idea was like a highway man, you know, to put your hands and empty your pockets and give them whatever you had.

**Wilkins:**

And give?

**Bohm:**

You know, to give over any money you had to him. The idea was —

**Wilkins:**

Oh, you mean the other people had to empty their pockets and give it to Adolph Stalini.

**Bohm:**

Yes that's right. To whoever it was appearing represented him.

**Wilkins:**

I mistook it. I thought you meant that all the followers had to give this salute and throw away their possessions.

**Bohm:**

No. The idea was that whenever you met one of their representatives you had to give the salute, which was to empty your pockets of money and give it to them and throw up your hands.

**Wilkins:**

I see. Give it to them. It was more like the bank robbers.

**Bohm:**

It was a robber, robbery you see. It was sort of a parity saying that's what the dictators were really doing.

**Wilkins:**

Of course the Baguan did literally.

**Bohm:**

He did it literally.

**Wilkins:**

He wanted all their property too. I see. I thought that each person had to throw away all their property.

**Bohm:**

No, no. They had to give it over.

**Wilkins:**

Hand it over, not throw it away.

**Bohm:**

Yes. Anyway, I think that's more or less all I can remember out high school. I went then to Pennsylvania State College.

**Wilkins:**

Hold up just a second. About the school teachers, can you remember any of the school teachers?

**Bohm:**



There were a few I can remember. There was the geometry teacher. His name is Mario Tope [?]. He's still alive and sitting there. Somebody has written that he plays tennis every day and he hikes. He's a very vigorous person. He's well over 80.

**Wilkins:**

Have you thought of writing to him?

**Bohm:**

I hadn't at the moment.

**Wilkins:**

He might appreciate it very much, you know. And you might get some interesting stuff back from him.

**Bohm:**

The physics professor was called High Writer, but I can't remember much about him. There was a biology teacher, Miss Boyd. I think that Tope was a dedicated teacher. The others were not bad. The English teacher was called Vic Bays, you know, the one where — That I can remember and he was half Indian, American Indian.

**Wilkins:**

Was there anything special about any of these teachers that you might possibly have picked up something useful from them?

**Bohm:**

I can't remember.

**Wilkins:**

And their sort of attitudes?

**Bohm:**

Probably only subtly. You see I think that Mario Tope must have taught geometry well to have got the spirit across. He knew my uncle apparently. This uncle, they had been friends as children, the young man, this uncle who was so vigorous and someone I used to admire. The others, you know, the thing was you could talk with them and so on. It was good.

**Wilkins:**

Do you remember any conversations you had with him?

**Bohm:**

No, I cannot remember, but I mean it wasn't difficult to talk with him.

**Wilkins:**

So they were quite approachable.

**Bohm:**

Yes.

**Wilkins:**

And reasonably friendly. This geometry, was this the thing about Euclid dynamical approach [?]?

**Bohm:**

Yes, and then solid geometry. That went next year.

**Wilkins:**

So the solid geometry was related to this whole business of ideas about four dimensions.

**Bohm:**

I got that idea from that, yes. But the idea of necessity, you see of showing that one thing followed, that the whole structure was necessary.

**Wilkins:**

Now you would see that that some of it was an illusion.

**Bohm:**

It's limited. It's so, but it's not as quite as absolute as I would've thought. But I mean at that time it certainly held my attention very strongly and interested me. The whole of science interested me. I was sort of fascinated to learn about all those things. I was also very interested in ancient history. History generally, but also especially ancient history because what fascinated me there was the scope of the thing, the rise and fall of civilizations. You saw the whole thing rather in modern history when we saw the rise and yet didn't get to see the fall. But you saw the civilization as a whole. As I told you, that idea made me — I used to project forward into the future all sorts of interplanetary and interstellar civilizations

that would rise and fall with all sorts of economic structures and financial arrangements.

**Wilkins:**

Did you see the American Civilization story, Man Through Our Rise and Fall?

**Bohm:**

Yes. I stepped somewhere around 2000 something or other with the gradual decay of this whole western civilization.

**Wilkins:**

When did the recession come in then?

**Bohm:**

Which recession? The Depression.

**Wilkins:**

Depression.

**Bohm:**

That was '32, but I mean I didn't picture that as the basic troubles as I assumed they would get over that.

But at some stage there would be a fall in the basic character of the civilization itself, just as the Roman civilization fell and the Greek and all these others, the Mesopotamian, Egyptian.

**Wilkins:**

So all has changed in a sense on that grand scale. But did we discuss this question of the Depression? I forget.

**Bohm:**

Yes we did. I mean, see the Depression didn't affect us all that much or even my friends, but it's general affect was a great deal because in the sense that the whole country was not working right. And that all these ideals about America were not working. We're being shown not to —

**Wilkins:**

Yes, so that you began to question this whole system of ideas.

**Bohm:**

Yes. That was the first question about rugged individualism. It had no meaning if 25% of the

people were unemployed and banks were failing. You couldn't get to the money you saved, you couldn't hold it in some —

**Wilkins:**

I interrupted you. You were starting to talk about Penn State because you got on scholarship or something.

**Bohm:**

No not scholarship; my father covered my expenses. I don't know exactly why I went there. My uncle had gone there, the older uncle, and several other people I knew were going there. People said it wasn't a bad school.

**Wilkins:**

It wasn't terribly far from your home.

**Bohm:**

It was 120 miles. In a way it was a very fortunate choice because — It was a very small physics department, only about two or three students there.

**Wilkins:**

How many staff?

**Bohm:**

Quite a bit more. I mean, they were teaching students in other departments like chemistry and premed and so on. There were only about four or five students all together doing physics in the whole —

**Wilkins:**

Was it a fairly small university then?

**Bohm:**

There were about 5,000 at that time. Right now it's about 40,000 I hear.

**Wilkins:**

There were very small fractions of students were specializing in physics.

**Bohm:**

Yes, that's right.



**Wilkins:**

Why was that?

**Bohm:**

Nobody knew about physics and it was not thought there were a lot of jobs in there and so on.

**Wilkins:**

What were most of the people in the university doing?

**Bohm:**

The biggest department was agriculture and then came chemistry and engineering. Then there were the humanities and some biology, there wasn't much. Biochemistry maybe, I don't know. But there's a lot of engineering especially petroleum engineering.

**Wilkins:**

A state university that had grown out of the economic needs of the area.

**Bohm:**

That's right. The physics department, its main activity was teaching these other students. One or two of the professors tried to do a bit of research on their own, but they didn't do a lot.

**Wilkins:**

So physics as a science, as an academic pure study so called was a foreign notion in this type of environment.

**Bohm:**

It wasn't foreign, it just wasn't done. I mean, people had the idea. There was mathematics for example and there were mathematicians who were pure mathematicians who prided themselves in knowing an application. It wasn't entirely foreign, but there wasn't any way to support a physics department except that way because there were no physics student to speak of — I mean, hardly any.

**Wilkins:**

You mean physics wasn't a profession in which you trained?

**Bohm:**

No. Well very few people would've thought of it as a profession.

**Wilkins:**

You had quite a lot of stuff there. They were quite interested in their subject, were they?

**Bohm:**

Well, some of them were.

**Wilkins:**

And they had time enough to discuss things with you.

**Bohm:**

They could discuss, yes. I mean, we had fairly free discussion, but the main thing was I would talk to the few friends I could talk with.

**Wilkins:**

Students.

**Bohm:**

Students, yes. There was this fellow Weiss who came with me from Wilkes- Barre and he was an engineering student, electrical, but we talked quite a bit for the first two years. Then we were roommates for the first two years. In the third year I met a fellow called Maynard Dawson, who was a physics student. I think it was physics. We used to talk a great deal and we used to solve mathematical problems. Whittaker and Watson, their texts are rather advanced texts beyond the scope of the course. We used to work on those problems together and talk about physics and mathematics and a few other things. There were a few other friends I had. One was premed and one was chemistry. The thing is that by doing that, by reading in the library, by working on things myself, and my thinking about things a great deal —

**Wilkins:**

Have they got a reasonable library then?

**Bohm:**

Yes. I was able to learn. When I got to Caltech I found I knew a lot more physics than people who had come from far better schools, like Columbia and all the bigger schools. The other point was that it was in a rural environment. Penn State, the college was the main thing that supported the town and shortly outside were nothing but farms and a little wayward mountains, wooded mountains in which I could walk, also on the farm roads. This was very important because otherwise I don't think I wouldn't have worked very well. I mean, if I'd gone to a city university I think it would've been very much more difficult psychologically.

**Wilkins:**

You mean you needed to walk in the woods, to so to speak, collect your wits and to be able to somehow get on the right wavelength.

**Bohm:**

Yes, to come to a balance again. So that was very readily accessible. I think it was lucky that I went to this. People who had gone to big departments, they

hadn't had access to their professors and they probably were more distantly. You know, they were rather not that close to each other and didn't talk that much to each other.

**Wilkins:**

These were the famous places.

**Bohm:**

Yes.

**Wilkins:**

That you learn less in a famous place.

**Bohm:**

That's right. The major point in learning was what you did for yourself as well as the ability to mainly talk with people.

**Wilkins:**

All this sort of heuristic stuff and also some dialogue.

**Bohm:**

Yes.

**Wilkins:**

Whereas in the famous places you were just had all the information stuffed into your head.

**Bohm:**

Yes, and there was very little dialogue. It probably also had so much giving to do that you had no time to work on your own. I mean, I just kept reasonably busy, but they had a significant amount of time for walking and thinking and so on.

**Wilkins:**

Could you say a bit more about this whole thing and walking in the woods and so on? Of course this has now become a famous phrase about a walk in the woods. It suggests that there was some sort of magic in the nuclear disarmaments discussion in Geneva, kind of a walk in the woods that the woods did a sort of magic and people were able to find solutions to problems they couldn't solve otherwise. To some extent this same notion I think that didn't Freshen

Mikena [?] for a walk in the woods when the penny dropped about the next nuclear fission. I think this is quite a recurrent theme.

**Bohm:**

Yes, it's a true problem. It takes away the tension and allows the mind to move more freely. I used to think when I was a child very young that if people could live in the forest they would be far healthier and friendly and more closely related.

**Wilkins:**

Why the forest?

**Bohm:**

Because somehow it seemed to me — I rationalized it by saying that's where we had all started or something. I don't know, but I must've read it somewhere.

**Wilkins:**

Sort of prime evil environment.



**Bohm:**

Yes. I must've read it, but I had the feeling that that would be a natural environment. That living in this unnatural environment of the city we all became unfriendly and nervous and tense.

**Wilkins:**

So it's somehow related to all of these folklore ideas about forests and being a kind of, I was going to say womb of mankind or something, where we're all in forests.

**Bohm:**

That's part of it. And also just simply being there you could see it was a quiet peaceful order. It's a natural order there and beauty.

**Wilkins:**

Wow! What a connection with the fact that all these trees are pointing up into the sky.

**Bohm:**

No, I don't know if it was that. It could've been that. It's just that the whole thing, the trees, the leaves,

the shade and the light. See the open plane you had this extra. Very often the light was too intense or the wind was too strong. Anyway, it's a bit monotonous.

**Wilkins:**

People have said of course the opposite. They've said that Arabs on camels going across an endless open desert or that's sailors at sea seeing no land for a long time. But this somehow was a stimulus for them to do creative thinking. I think this idea of being put forth.

**Bohm:**

That's also been put forth. I mean, you can, that may have that effect, the sea, as well because it's in movement.

**Wilkins:**

Oh, bird watching.

**Bohm:**

Like the flowing stream, watching the flowing stream.

**Wilkins:**

Or even with a plane across the sky, that movement to some extent always changing.

**Bohm:**

It seems a bit too mechanical. That is possibly sitting a train crossing the prairie or something might do something. But anyway I used to like to walk in the forest and the mountain. They were really forested mountains. They weren't very high, maybe 1,000, 2,000 feet.

**Wilkins:**

But I mean don't you think the fact that the trees are bigger than you and they're like sort of a forest is often being compared with a cathedral with the sort of reaching up into spirituality and bigger things than oneself and all this sort of notion. I mean, the trees, it's an amazingly impressive. It's a living thing which is so much bigger and stronger than we are, isn't it?

**Bohm:**

That might be part of it. It was partly the sense that it was all growing freely in the wild.

**Wilkins:**

It was a wild aspect then in the groves.

**Bohm:**

Yes. For example, when I later got to Pasadena, which is basically a desert except that they water it, that I felt well, these trees didn't interest me so much because they only grew because people forced them to grow.

**Wilkins:**

So that the main feeling you had about it was growth and freedom to grow and the activity of growing.

**Bohm:**

Yes, in the wild.

**Wilkins:**

In the wild, yes wild. So wild is freedom from constraints.

**Bohm:**

Constraints of civilization, yes.

**Wilkins:**

So it was the wildness and the groves and the freedom. I think it's important to get that. It wasn't often purely the height of the whole thing.

**Bohm:**

Well, later in California when you got to these Redwoods then I felt that. But you see the trees were not all that large in Pennsylvania. It was really second growth mostly.

**Wilkins:**

So it was a little bit more like van Gogh Starry Night or something where you have all those tornadoes sort of going across the sky. All these sort of files moving along amidst activity, where many of his paintings showed immense sort of activity in the landscaping things, sort of a wild semi-organized type —

**Bohm:**

?I was laid down in a very [???] way, and also generally an ugly way, and so on.

**Wilkins:**

I agree Berkeley wasn't really very wild, was it?

**Bohm:**

No. It was pretty ugly, the city itself. Penn State, the state college wasn't ugly, but the whole environment was close to this mountains and farms and so on.

**Wilkins:**

You mean you could just walk out there in just half an hour, you could get —

**Bohm:**

It would take you half an hour to get to the mountain. You would walk through farm land in which the mountain.

**Wilkins:**

If you had just an hour and a half to spare, you mean you could spend the hour getting there and back and

then half an hour in the mountain. The rest of the time —

**Bohm:**

Yes. Or if you had an afternoon, right after eating you could go there and have a long walk and come back.

**Wilkins:**

You'd have several hours there in the mountains.

**Bohm:**

Yes.

**Wilkins:**

Were they mainly deciduous trees?

**Bohm:**

Yes. A few conifers, but mostly deciduous.

**Wilkins:**

What about streams?

**Bohm:**

There weren't too many streams in that area. There may have been one or two, but there weren't a lot of streams. There was a lime stone region I think was —

**Wilkins:**

So the motion of the water wasn't an important element in the —

**Bohm:**

Not there, but other places it was, yes.

**Wilkins:**

That was the growth of all the vegetation and the trees.

**Bohm:**

And also getting up on the mountain and having a vista.

**Wilkins:**

Getting a view.



**Bohm:**

Yes.

**Wilkins:**

To look around. Maybe even send out sort of searchlight theme so to speak or they could impinge on you from a distance.

**Bohm:**

But anyway, in the whole I enjoyed the thing. There were a few features I didn't like. We have to have in the first two years what they called ROTC Reserve Officers Training. With it for an hour or two a week marching and doing things and sometimes tried —

**Wilkins:**

You mean you had to do ordinary square bashing?

**Bohm:**

Yes.

**Wilkins:**

Counting rifles?

**Bohm:**

Yes. And then sometimes target practice and so on.

**Wilkins:**

So you were drilling you mean?

**Bohm:**

Yes. I disliked that. I did try to —

**Wilkins:**

But you actually did it.

**Bohm:**

Yes, well you had to do the thing. I tried to march the way they said and finally one of the student officers came up to me and said, “There’s some people who just can’t move along with the others. They have to go on their own.”

**Wilkins:**

What did he do about it?

**Bohm:**

Nothing. He just said, “Well you’re one of those who can’t fit in with this.”

**Wilkins:**

You mean he accepted the fact that you would be marching with the others, but couldn’t really do it properly.

**Bohm:**

I couldn’t stay in step. He said, “Some people just start walking on their own.”

**Wilkins:**

Of course, Einstein was apparently recoiled very strongly against this whole thing about seeing men marching together.

**Bohm:**

I was trying to do it, but probably unconsciously I was recoiling against it. I didn’t like the whole thing. I was glad at the end of two years we didn’t have to do any more. Some people elected to go on of course and I mean they joined the reserve.

**Wilkins:**

But basically it's a sort of brainwashing type of activity isn't it to turn you into a machine.

**Bohm:**

Yes.

**Wilkins:**

This is very important from the military standpoint, so you don't think for yourself too much. And you had to do target practice.

**Bohm:**

I wasn't too bad at target practicing.

**Wilkins:**

Did you in any way enjoy sort of shooting?

**Bohm:**

Well, if I could hit the mark.

**Wilkins:**

You found that enjoyable.

**Bohm:**

Yes.

**Wilkins:**

What about the sense of power of the gun?

**Bohm:**

I don't know if I was thinking of that. The ability to hit the mark, you know, to —

**Wilkins:**

You did find a certain fascination in this.

**Bohm:**

Yes. It wasn't a very strong gun so.

**Wilkins:**

And you were reasonably good at it.

**Bohm:**

Yes.

**Wilkins:**

Were there any other aspects of it?

**Bohm:**

No, I can't remember any more. You see all we did was march and do what do they call them, maneuvers like about — I can't remember what they —

**Wilkins:**

Old parade grounds and stuff.

**Bohm:**

Yes.

**Wilkins:**

Did you wear any uniforms?

**Bohm:**

Yes, they issued us a uniform to wear.

**Wilkins:**

Really?

**Bohm:**

Yes. And you had to return it at the end.

**Wilkins:**

How many hours did you do this?

**Bohm:**

Two hours a week.

**Wilkins:**

Just two hours a week you put on the uniform and march around the parade grounds.

**Bohm:**

Yes. A lot of people used to use the uniform whenever they had any dirty work to do so they wouldn't use their own clothes. Anyway, I was glad that was over. I can't remember too much. We had a course in organic chemistry. I took a lot of chemistry because chemistry was emphasized there so much.

**Wilkins:**

Simply because of practical application.

**Bohm:**

Yes. Physical chemistry. I remember we did some experiments trying to work some things out. This

idea about Langmuir we tried — Langmuir had the idea at that time of some sort of soap like films.

**Wilkins:**

His bi-layers you mean.

**Bohm:**

His bi-layers and we were playing around with them. I can remember making those.

**Wilkins:**

This gives you an immediate apprehension of molecular dimension.

**Bohm:**

There were various things we did. We had our courses in physics. There was one course in physics, I remember electronics really. It was a young man who had just come was teaching it and I discovered an error in the book. I went up and told him. He was very disturbed by that. He says, you know, it's not the place of students to point our errors. So I just kept quiet because it was no use saying anything to him. The next day he came and apologized.



## **Wilkins:**

I see! Oh well, that's good. It must have just shocked you. You must have been so taken back he really didn't know what to say. Went away and thought about it. I remember in Cambridge when I was undergraduate one of my lecturers brought out a new book on crystal physics. The one diagram in the book, which had an error in it, was a terribly serious one. It wasn't a very real error, was selected by the publishers to go on the front of the dust jacket. I felt obliged to go and point that out to him. He didn't seem terribly interested. He didn't seem to even be very concerned, which shocked me even more.

## **Bohm:**

Later when I wrote this on quantum mechanics in Princeton I made a lot of errors because usually I'll explain that later. I didn't work and didn't think about the conclusions. I used to use a nonmathematical way of coming to the conclusions always and then I would have to fill in the equations for the book. So naturally the steps were often wrong. Then students later wrote and saying there are all these errors. I'd had an assistant and we

weeded out about 400 or 500 errors, but there was still a number that go through. So they would write saying it was very infuriating to have all these mistakes and have the answers always coming out right.

**Wilkins:**

But did you know the answer somewhat intuitively?

**Bohm:**

Yes. So I'd have to fill in the equations as a matter of convention. You must arrive at the answers by means of equations.

**Wilkins:**

I read somewhere that people didn't understand Feynman originally. That they thought he was some kind of unsound person until they realized that he did rather the same, that he intuitively saw solutions.

**Bohm:**

I'll tell you more about Feynman later. But roughly people didn't appreciate his stuff at all until Dyson came along and showed the connection between his work and what Schwinger had been doing. That

Feynman's methods would be far more affective. But until somebody had proved that they just sort of didn't take it seriously. Later on when the times come we can discuss Feynman because I have a number of contacts with him. Anyway, I remember I used to walk sometimes on the farm roads, you know, sort of dirt roads, and think. If there was something puzzling I always wanted to work it out, to get a feeling for it without what it was directly. The same as we were discussing before about vortices. For example, the gyroscope used to puzzle me — exactly why and how does it work? Finally I got a feeling for it of saying as the wheel is turning and you're also turning the axis then if you imagine yourself moving with one of the particles of the wheel you can see it's being driven a right angles. It's going to move at right angles to the way you expected. You can get the feeling of why that happens. That's the sort of thing I wanted to do. Not merely to explain the thing in purely logic steps, but to get the feeling of how it works.

**Wilkins:**

That would then be more reasonable.

**Bohm:**

Yes. I gradually was getting to the point where I wouldn't accept the proof unless I could directly see the reason for the result without the proof. In other words I didn't trust the steps in between. I said, "Either they might be mistaken or you might have all sorts of assumptions that you didn't know you were making."

**Wilkins:**

You wanted a more direct apprehension, so to speak.

**Bohm:**

Yes. There was another fellow whom I knew a little bit called Sekancon [?]. He's written to me recently from California now. He saw some of my later stuff, and he's saying that the ideas in there were already implicit in what I was saying, but I can't remember that. But perhaps I'll have a chance to talk with him some time.

**Wilkins:**

You mean it goes beyond the merely sort of style of thinking. He was being a bit more specific and to look at the actual products —

**Bohm:**

Yes, the latest stuff. Yes, he thought that? So?

**Wilkins:**

See, I don't know about this chap Holton. Have you ever read any about all this thematic something or another in science? I never bothered to read any. I've been told it's really rather over rated. But I suppose that obviously there's some truth in it. Because I mean many scientists must have certain sort of basic themes in the way they think, which probably goes through their whole careers, doesn't it?

**Bohm:**

Yes.

**Wilkins:**

I think that's probably all it's about. Actually maybe I ought to have a glance at what Holton says instead

of deriding him like this because I know intelligent people who've derided him in him saying it's puffed up too much. But it might be applicable in the development of your sort of whole thing. You've never read any Holton?

**Bohm:**

Well, not that much, no.

**Wilkins:**

The other thing of course he did was all of this stuff about how Milliken fudged his results on the charge of the electron and apparently this is rubbish. I met him in America recently of being also that in great and careful detail. He said, "Really there'd been no fudging at all. It was all very clearly established." And all this hoax and stuff about him fudging the thing is a complete dirty mess, rubbish. It shows how some of these philosophers of science can take and yet that Holton story about Milliken is all around the place everywhere, you see.

**Bohm:**

Well, it has a bad effect I suppose.

**Wilkins:**

It's interesting. It makes news.

**Bohm:**

People like to debunk things.

**Wilkins:**

Exactly. To say that Milliken was a sound scientist for sure — we knew that already. To say he was unsound, they say, “Oh really?” It's like those cheap newspapers. That's an interesting point about this. I wonder. You haven't bought any facilities for getting any of these discussions — I don't know. It's difficult, I don't know what they're going to do with all of these tapes, but in a sense this is your problem.

**Bohm:**

I think I'll have to make notes when I write.

**Wilkins:**

I mean theoretically and if you get the whole bloody thing in transcript you could then just go through sort of mark, cutting, chopping those bits out you wanted and then reassembling it.

**Bohm:**

No. I think it's better to write as fresh from the information you can gleam from it.

**Wilkins:**

That means you've got to construct the sentences and everything. It might take you ages.

**Bohm:**

No, it won't take that long.

**Wilkins:**

Won't it?

**Bohm:**

No. I mean, it's a matter that to have all this typed would be a gigantic challenge.

**Wilkins:**

Yes it would. It would cost money too because presumably you haven't got facilities at Berkley.

**Bohm:**



No. Well, I don't think these typists could really, and they're not the sort that could even do audio typing. I mean, they're not that good at it. Maybe, but to type from a tape requires a certain kind of skill.

**Wilkins:**

But it's not — They have special machines so they can stop and start exactly.

**Bohm:**

Yes. Well they might, but I don't think it's really worth it because —

**Wilkins:**

Well, if you think you can do it well good luck to you. Well, you'll find out won't you? Maybe you're quite right. I was just thinking that if you could've sent some extracts of these discussions to some of these people, it might interest them a little, and you might get quite of feedback from them.

**Bohm:**

Yes. I was hoping that I could see this fellow Sekancon when I go to California, and there are a

few others I might find. But try to get hold of some idea of what we were doing. I can't remember, but I used to have these long discussions with Dawson.

**Wilkins:**

This again a fellow student?

**Bohm:**

Yes. He was more interested in mathematics than physics. So we used to solve these problems in Whittaker and Watson and we'd talk about physics.

**Wilkins:**

Solving the problems was more sort of, was it in a way sort of like doing cross word puzzles? There was more to it?

**Bohm:**

Well, no. There were difficult problems. I mean, it was quite an advanced text. It was really a graduate text.

**Wilkins:**

But it was basically a technical matter wasn't it?

**Bohm:**

No, it was not at all obvious what to do.

**Wilkins:**

So it was more sort of creative mathematics.

**Bohm:**

Yes. They were taken from the Cambridge Tripos and things like that some of them. You know, there were a whole collection of problems some of them quite —

**Wilkins:**

Quite interesting questions then.

**Bohm:**

Yes. In fact Whittaker and Watson was rather more advanced than most graduate mathematics departments would've used for analysis. I used to try to discuss a few philosophical ideas at the time. One of the ideas that interested me was this. The notion

was that suppose everything were reducible to physics to some sort of mechanism. I used to say well what does that mean for my freedom. You see, I was thinking about it. I was saying well maybe it doesn't matter if the molecules move that way as long as I feel that I'm free then it doesn't matter whether it's determined by the molecules or not. That was the nearest solution I could get at that time.

**Wilkins:**

And it was alright to live in a world of illusion then?

**Bohm:**

I didn't even know if it was exactly an illusion. I would say that I didn't picture it exactly as an illusion.

**Wilkins:**

But were you assuming everything was really predetermined?

**Bohm:**

Under that assumption, yes, that would be a mechanism at one level. But at that stage I felt anyway even if it were that we would have freedom

at our level. You see that in some sense. I don't know if it was a complete solution or anything like that, but the problem was the first time I'd really considered the problem.

**Wilkins:**

So you were beginning to tussle with the whole problem of determinism and free will.

**Bohm:**

Yes.

**Wilkins:**

And then the physics.

**Bohm:**

Yes. At that stage I think we'd heard a little of quantum mechanics, but it's revolutionary implications were not —

**Wilkins:**

This is an interesting point. What year roughly was that?

**Bohm:**

What? It was '35 to '39 you see the first four years of college. So people knew some quantum mechanics, but the implications of it had not sunk into most people.

**Wilkins:**

And it wasn't getting into university teaching much?

**Bohm:**

No. Only a few rules about work quantization, things like that.

**Wilkins:**

Yes, because you see it's very interesting because there were some higher education institutions in this country, I think, which weren't even teaching any quantum mechanics. I think even after the war. I did physics at Cambridge, which I suppose is one of the most advanced med schools in the world. A sort of center of physical science, and one was getting all the latest stuff with people like Dirac around.

**Bohm:**

We weren't getting anything like that.

**Wilkins:**

The university environment for physics is very variable at different places.

**Bohm:**

Well, we had heard of the rules of quantization and some, but still we were thinking basically classical end. Everybody was. Even relativity hadn't made it. We knew about it, but it hadn't made that strong an impression.

**Wilkins:**

We had Eddington as an undergraduate. In my first or second year I went to a lecture, a talk which Eddington gave in the evening after dinner at my own college. One could sit there and you would ask this chap questions. I said something about it's a 137. I said, "Well Professor Eddington, do you think studying these methods is the most important thing that human beings can do?" He sort of gulped a bit and looked at me. He said, oh no when you put it quite like that. I was just a silly undergraduate who could go and ask questions. It was a very stimulating

in some way environment having all these great people around. But you could go and knock and the door and go into their rooms and say look I've got a question, approach them. It was a remarkable center. It was interesting that you were in some ways what you might call in a very deprived environment, but it had special features which are very helpful to you.

**Bohm:**

Yes.

**Wilkins:**

It's interesting. It wasn't a good or bad environment.

**Bohm:**

Yes. To have been exposed too fast to these other things might have been discouraging from the point of view of understanding. You have to go through to build it up, to get stages.

**Wilkins:**

Going at it slowly may have been a help to you, whereas I certainly my impression at Cambridge was we were just rather sort of pushed through all the latest ideas and this was it. That there weren't really



any great questions. All these we worked out by these great people in the last few years and that was it. They had it all sewn up was the general impression what I got from physics.

**Bohm:**

I didn't get that feeling. I got the feeling that there would be all sorts of interesting and great things that could be done. Not that I knew what they were or anything, but —

**Wilkins:**

I think this is really rather interesting, because you see on the other tape you talked about when you were at Princeton and you were banned from going into the university, how you were freed from the need to conform in your conversation and discussion with the other scientists. This was an advantage. And here you are with another thing where deprivation gives you freedom.

**Bohm:**

Well, freedom comes in a way which is hard to prescribe. Having ideas pushed on you too fast to assimilate them is not freedom.

**Wilkins:**

No. I think it also depends on your ability to so to speak live on a poor diet. I mean, most people who would have limited capacity to do anything original wouldn't have thrived in such a deprived environment. They presumably would just need a more conventional approach of being handed solutions, wouldn't they? It would depend on one's ability for original work.

**Bohm:**

Well, you see I don't think that the, you know, the physics department didn't do a lot. They gave a few courses and we talked occasionally with the staff. But most of what I learned was primarily up to me to read and to talk with people and solve the problem.

**Wilkins:**

Well, you had a lot of time. I must say this is very important. I think this is the greatest criticisms of university science I would say in this country is the students don't have any time to think. I often ask students do you ever have time to think about what you heard in that last lecture. They sort of look at

you blankly. They say, “I haven’t gotten any time to think.” They’re always rushing along. This is what university is supposed to be about, thinking. I don’t know how they do it.

**Bohm:**

Well, they never give it to you. I think I was lucky as I said because when I got to Caltech I found that I knew a lot more about many things than these people from better universities.

**Wilkins:**

When you say you knew it, you mean you understand it better?

**Bohm:**

Well, I understood it better. And I also had more knowledge actually, which I’d picked up on my own. The courses were not as good, but.

**Wilkins:**

Well, not obviously you needed reasonably good libraries, and you had that. If maybe you had just been living on a farm you couldn’t have done it.

**Bohm:**

No. But also I needed people to talk with and keep it going and so on.

**Wilkins:**

You met reasonably good other students to talk with.

**Bohm:**

A few, one or two. There was really one really in physics and that was all and one or two others here and there, but it was a matter of luck.

**Wilkins:**

But the electrical engineer still sort of had — I think you said one of them was an electrical engineer.

**Bohm:**

Yes.

**Wilkins:**

I mean he still had sort of broader interests about electrical engineering and human life generally.

**Bohm:**

I think in the whole I was fairly happy during that period and there was no serious conflict of any kind.

**Wilkins:**

You got away from home I suppose.

**Bohm:**

I got away from home, yes. In the beginning I had a problem with food. Remember being Jewish we were not supposed to eat anything that's not kosher. So for a while I thought I would keep off meat, but within a month or so I was feeling pretty terrible. I was eating in these cheap restaurants because you can't get a non-meat diet in those cheap restaurants that's adequate. So finally I just switched over and said, "Well, stuff it."

**Wilkins:**

What was your living accommodation?

**Bohm:**

The first semester we were in the dorm. It was a college dorm, staying with Weiss sharing a room.

But it was so noisy we couldn't stand it. Then the second semester we moved over to a room in a private house. After that we were in private houses.

**Wilkins:**

But you didn't cook your own food.

**Bohm:**

No, there were no facilities.

**Wilkins:**

You had to go out to restaurants.

**Bohm:**

We ate in restaurants, yes. There was diner, it was called Boots Diner.

**Wilkins:**

But the university didn't provide good food.

**Bohm:**

No, no. Only in the girls dorms they provided food, which was notoriously bad they said.

**Wilkins:**

All the men had to go out and buy their own.

**Bohm:**

In the fraternities they could have food of course, but everywhere else you had to go out and buy food.

**Wilkins:**

Did they cook their own in fraternities?

**Bohm:**

No, they were cooked, you know, they had cooks.

**Wilkins:**

So this is some special sort of privilege which —

**Bohm:**

Fraternities are for more wealthy people.

**Wilkins:**

But they had to pay for it.

**Bohm:**

Yes. The whole thing had to be paid for. They lived in the building and it was much more expensive. But we lived in these rooming houses and went out to eat. Sometimes I would make breakfast of cereal and milk there, but otherwise we had to eat out.

**Wilkins:**

All this university life is very different from the European model. You don't know how much it varies in different parts of Europe either.

**Bohm:**

That was in those days. I don't know what it's like now anyway.

**Wilkins:**

We've really gone on a little bit longer. Look, this is what we've done.



## Interview Session - 3

**Wilkins:**

I thought you said something in your last time when you were talking about being an undergraduate at Penn State that you'd begun to think about this matter of you as a human individual being part of a whole cosmos.

**Bohm:**

In that sense I was thinking about it even before high school because I was thinking as a model of the cosmos.

**Wilkins:**

You mean at high school.

**Bohm:**

Yes. Because I had the four-dimensional model where each atom was a three dimensional tomb and a four-dimensional stair reaching toward the center. I had the idea that each of us was built out of these so that I too was a four dimensional tube. In other

words I had sort of a place for myself in this whole model.

**Wilkins:**

You were a four dimensional tube.

**Bohm:**

Or actually I could be made of atoms that were four-dimensional tubes.

**Wilkins:**

You mean that every part of the universe fitted together to form a whole.

**Bohm:**

Yes.

**Wilkins:**

It was one complete structure.

**Bohm:**

Yes and they interconnected in the fourth dimension because although they may look separate they would also meet at the origin.

**Wilkins:**

So there was an underlying unity which wasn't apparent through a limited view of the system.

**Bohm:**

That's right. We were only aware of the three dimensional cross sections.

**Wilkins:**

I meant to ask you about this earlier model, because I wondered if that was the — I think that's very interesting. So that was roughly at the age of what?

**Bohm:**

17.

**Wilkins:**

17. Doing what we call sort of A levels.

**Bohm:**

Yes. I was doing solid geometry at the time, physics knowledge.

**Wilkins:**

I mean presumably it was a somewhat philosophically satisfying notion to have about all this unity and things fitting together.

**Bohm:**

The idea was I wanted to make a theory of the whole sort of having Einstein connecting at the hip of a person. That probably set me off on that track. I understood he made a higher mathematical theory, but I wanted to make one that was more evenly imagined. I didn't understand his theory when we studied it, but I realized that if I'd stayed in mathematics then.

**Wilkins:**

Then at Penn State you were learning about quantum mechanics and so you began to —

**Bohm:**

Well no, it was really classical mechanics, which raised the question about whether they had any choice or not. The idea was that we didn't really take quantum mechanics all that seriously at Penn State. We learned a few of the rules, but the spirit was still classical mechanics. And I was thinking these atoms could be deterministic and we're made of those atoms. The question is did people have any freedom. I think that — I don't know how I could put the answer. But as long as each one of us was able to fulfill himself, to fulfill his potential in creativity — I wouldn't use those words, but I didn't worry about whether it was deterministic or not. That was the solution I came to; that whether it was determined or whether it was some of something else.

**Wilkins:**

In a way you mean the notions of creativity sort of transcended any moral sort of primitive notions about determinism.

**Bohm:**

Yes. I guess I sort of felt that freedom could only be freedom to be created and that's what I felt.

**Wilkins:**

I must say I certainly feel that this was a truer way of approaching things. You sensed that the — you had a feeling for the general nature of creativity and you saw this as being the essential aspect to human existence. And all these intellectual notions about whether there was causality or determinism or free will, to some extent you saw as being not so basic because these were somewhat artificial sort of intellectual concepts.

**Bohm:**

I didn't see it in those terms then. I just felt that one didn't know, but whatever it was the main point was creativity.

**Wilkins:**

But I mean you still had a general feeling for looking at it that way even if you didn't articulate it. I mean, this is surely the thing that any ideas which are worth anything generally speaking are preceded by sort of a general kind of feeling about the nature of the solution. Which is only then put in some parity

in a form of sort of intellectual propositions and thoughts and so on. So it was a later stage, wasn't it?

**Bohm:**

Yes. Penn State didn't really concentrate so much on the total nature of the universe. It was learning more of different things. But I had in mind that eventually I would get on to that thing, again later.

**Wilkins:**

Get onto what?

**Bohm:**

This whole profession of the wholes.

**Wilkins:**

When you were at Penn State you —

**Bohm:**

Yes. Reserved the fact at the back of my mind that I hoped that maybe I'd in graduate school or later get on with that. I had to learn more first.

**Wilkins:**

So you had a general formed ambition at that stage that this might be the sort of problem that you might like to almost devote your life to studying this idea of the relation of the individual to the whole.

**Bohm:**

Yes.

**Wilkins:**

But you would realize that you would need probably quite a lot of education and training and knowledge and so on to be able to work effectively on that problem.

**Bohm:**

Yes.

**Wilkins:**

Now look, what I'm going to say now is indulging in a little bit of psychological speculation. But what I wonder is what you feel about this in that most of your childhood was spent in a state, I was going to say somewhat painful suspended existence where



you were not really very effectively integrated into a family or social scene. That your both parents were somewhat, your relationships were not very close or effective, that you certainly didn't have the feeling that you strongly belonged within your family. I think that's true, isn't it.

**Bohm:**

Yes.

**Wilkins:**

Nor did you feel you strongly belonged within the Jewish community. Maybe you had some feeling of belonging amongst your friends, the other boys.

**Bohm:**

Yes, but that vanished as they got older and each went their separate ways.

**Wilkins:**

So that you as an individual, you might say, I mean would you say it was a somewhat painful existence as an individual being not belonging to these other things which people normally tend to belong to, to family and social group and so forth?

**Bohm:**

It's hard to say. I didn't get a very favorable view of the family either in my family or in the other families.

**Wilkins:**

Not only your own family, but the other families.

**Bohm:**

I used to get a picture going into the kitchen of some of these boys and just sort of warm and friendly and laughing. But one could see that it wasn't really all that good once you got to know them better.

Especially as I got older. I didn't actually see the great family life anyway. There's one memory I can remember. I was probably about eight or nine, but it was a memory of a much earlier period when it would sometimes come to me a memory of something happening at my grandfather's house and everybody getting together in a wanting to learn environment.

**Wilkins:**

Was it some special occasion?

**Bohm:**

No. I can't remember. It was just simply a lot of people who were there who were from New York and different places. It seems that it was a lively close relationship, but that sort of faded away and those people separated and got older and so on.

**Wilkins:**

Was this really rather a sort of strongly pleasant impression you had of all these people getting together and being friendly and warm in some sort of home?

**Bohm:**

Yes, that's right. Also, being very free and easy.

**Wilkins:**

Coming out of themselves to some extent in the home as people say.

**Bohm:**

Yes.

**Wilkins:**

I think some family get-togethers can be very nice.

**Bohm:**

They weren't even formal get-togethers, but there happened to be those people around.

**Wilkins:**

But anyway, they were there.

**Bohm:**

There were quite a few people around who later had to separate.

**Wilkins:**

People happen to be there and were together.

**Bohm:**

I think it was a residue of the older European environment where the family was much closer. And America tended already to be much less close.

**Wilkins:**

Yes. You mean that the European culture people had more established roots, where the root is of being belonging because you're rooted in the soil. In a sense you belonged to the soil.

**Bohm:**

They belonged to the family. They were not peasants or anything.

**Wilkins:**

When I say soil and roots I mean socially and not necessarily of the land, but in the culture.

**Bohm:**

In the culture, they were rooted into the culture — in the Jewish culture. So you see, people who came from Europe often remembered — You see, my father had similar memories of his European childhood and he would say it was something tremendously — I was at least ??? to what was going on in America.

**Wilkins:**

You mean he did feel it was something very valuable that he'd left behind.

**Bohm:**

Yes, that was gone. When somebody came from Europe they would come tremendously alive in some way. He had memories of tremendous friendship and people taking trips in high mountains and all sorts of things.

**Wilkins:**

A great deal of vitality.

**Bohm:**

Yes.

**Wilkins:**

It was taking all these forms within that cultural tradition.

**Bohm:**

Yes. He had memories of that and I used to feel uneasy when he felt that Europe was so much better than America.

**Wilkins:**

You felt a bit undermined — you weren't in Europe.

**Bohm:**

But he used to also look to the past. He used to sing a song quite often, which was to turn back the universe to yesterday.

**Wilkins:**

I suppose on the other hand he was — I mean, after all he'd come to the United States because it wasn't all the joy —

**Bohm:**

No. It was impossible to live there.

**Wilkins:**

Yes, quite. Even if they had a good spirit there, there wasn't enough material to live on.

**Bohm:**

He never felt that the United States equaled that, though he liked it in many ways.

**Wilkins:**

I must say I got the same impression with the Indians and Chinese in Malaysia. I think I said this before. I've heard it was tragic the ruthlessness of these people. The young people growing up there, there's nothing but skyscrapers and guta [?] factories. Now it's got no sort of cultural base. Very thin at least, the traditions which carry over.

**Bohm:**

Yes. I understand that in America the cultural [inaudible].

**Wilkins:**

Yes, but on the other hand, of course given time, these countries built up their own culture. I mean, the Australian's are building theirs up and the Americans have gradually built theirs up. But I think probably it is still tends to be thin compared with the European stuff. Incidentally, did you watch any of the television program comparing Dorset Village in the country?



**Bohm:**

No. I've heard about it.

**Wilkins:**

It's quite interesting. The main thing that they don't bring out, which I think is really silly, they don't bring out a lot of the differences due to the French Revolution — all the égalité business. Or the lack of domination by the local landowner, which is the case in the British. I think it's a shame because it was a very interesting comparison, but the background political-social history isn't brought out.

**Bohm:**

Anyway, I felt that the American family, particularly as it went toward the lower class, one of my older uncles was living in a lower class district and I felt that the whole area was cold. Whereas some of that warmth was still left in the workman's class, occasionally at my grandfather's, but he was getting older, and the whole thing. My grandmother — but

you see, as they got older they didn't have that vitality anymore. People getting [??]

**Wilkins:**

You mean people's behavior or passions tend to persist, you mean, into a historically changed situation.

**Bohm:**

Yes.

**Wilkins:**

I don't know how you feel about it, but I sometimes feel that people like myself; we're a product of pre-World War II university students. Universities like Cambridge with sort of left wing ideas and a whole sort of structural environment there, which has in a way determined our general approach to life. And the younger people growing up now, they approach things rather differently. I know it feels in a way a

little bit like that. We're like this sort of dying breed. It's the same when you go Hampstead [?]. You see all the very old people crawling around the streets and some are barely crawling now. And you realize that all this great European refugee culture which came out of Europe with the rise of Hitler pre-war that all these people are dying out. And the newer generation that follows that is not the same. They're much more matter of fact young sort of British people. A special quality of that theme is gone. I think it's tragic in a way. I mean, it just hit me the other day walking around Hampstead. I'd always taken these Jewish refugee elements for granted. What fine, you know all this wonderful European culture? It's going to die, a lot of it.

**Bohm:**

It's dying in Europe, too, because of naturalization.

**Wilkins:**

Yes, it's dying. And of course to some extent I suppose in history the cultures are always dying to some extent and reforming in other ways. But there's certain periods where you seem to have particularly harmonious and creative cultural

passions operating and at other periods they seem much thinner and weaker. Oh well, I should talk. They're all fuddy-duddies when they take the past, but I'm correct when I say lamenting the past just as your father lamented it. In a sense he was right.

**Bohm:**

Yes. Well its part almost in the Jewish religion. There were these prayers where the Jews were scattered, they were conquered thousands of years ago and taken to Babylon in captivity. So they lamented their old lives and that's part of the whole.

**Wilkins:**

So that was a very standard, sort of general principle.

**Bohm:**

Anyway, that was sort of one of the threads to lament a better past in which I probably reflect to a certain extent. But I also picked up the idea that the future would be radiant and glorious, you see. More from the heart environment.

**Wilkins:**

So your four-dimensional model was putting threads between the present and the past and the future and making everything up as a whole.

**Bohm:**

Yes.

**Wilkins:**

But he was linking it with so to speak invisible threads, which are in another dimension.

**Bohm:**

Yes.

**Wilkins:**

Whereas in the real cultural world, of course, people were linked by visible threads in a way. You could readily see what the cultural persons were. I think more what I was getting at was this, that I was wondering to what extent going through a certain adversity in some degree a deprivation of unity within the family and the community, that the

creative reaction to that deprivation is to turn it into something positive where you have a stimulus to build up general thinking and theories which are going to transcend the deprivation.

**Bohm:**

Well I've been here and also the political interest was in a similar line to say that the future would bring people together in a way.

**Wilkins:**

In harmony.

**Bohm:**

In harmony, right. So that first of all the science would help end poverty, which I then regarded as the principle problem. Second, it would make people rational and then through proper politics people would get together to build a better society.

**Wilkins:**

I suppose it was just as well at that time that some demon didn't come along and give you a view of the

present as far as it wants to cope with. They got Reagan parading all the battleships in front of the Statue of Liberty to show what big strong boys we are or he is — the liberty to destroy the Nicaraguan government.

### **Bohm:**

Anyway, I think that that was merely most of it I could say about Penn State. Toward the end, the last semester I remember I took it a bit easier. I cut down the number of courses I took because I'd probably never been able to go and I took more time for just thinking about things. But you see, where I had to apply for the universities for graduate assistantship to be able to go on — As I said I applied to quite a few of them and got negative replies from most. But later I found out as I told you that the head of the department that recommended me had said we wanted to take Jews and so on. You see this place in Rochester happened to have a Jewish head of a department and money to lend, and of course it didn't bother them. So I did get an assistantship at Rochester.

**Wilkins:**

Why was it do you think that they had this aversion of this —

**Bohm:**

You see that's part of the whole background.

**Wilkins:**

Some sort of fear.

**Bohm:**

Well there was fear of their possible abilities, but also feeling that they were pushy and aggressive and they projected all these things, and of course some were.

**Wilkins:**

Some were because I mean the discrimination sort of always makes it that the discriminated people —

**Bohm:**

And some people have religious residue of religious prejudice, which [???] given up religion, but it still holds. I remember one evening toward the end of



this last semester I couldn't sleep. I [??] surge of energy, you see, and I didn't sleep at all. In the morning I went for a very long walk at sunrise. When I got back there was a letter waiting for me saying that I had received this White Fellowship for \$600, which was more than enough to cover a year's expenses then. We decided to go do away with a year of our life. Also, meanwhile I received an offer from Caltech for just tuition, so I decided I would go to Caltech. The reason for that was, we've already gone into this whole dream of the West and so on. So I had read that Caltech had had Einstein and a lot of people there and you must have —

**Wilkins:**

Oh, Einstein being at Caltech?

**Bohm:**

He was there for a while and some others as well. So I thought it must be a great environment and extraordinary place. It had a very good reputation wherever you asked them, therefore I thought I might as well go there and because I wanted to go to California any way. That was the decision. I remember them, I set off the following September

for Pasadena. Somebody had advertised that they had half of a bus ticket that they hadn't used so I went and bought it for about \$30. I got on a bus one morning and that was the morning war was declared. I remember that people were talking on the bus about it.

**Wilkins:**

What about your parents? Didn't you go home to see them first?

**Bohm:**

Actually I stayed home during the summer. The semester ended in June and I had this fellowship, but I stayed at home until September. In September I bought this ticket and got on the bus.

**Wilkins:**

From your home area.

**Bohm:**

From that home area, Wilkes-Barre. That was the day war was declared. Well then people talked a bit about it, but gradually interest subsided. So we were off on this bus crossing the country and on and on

and on. I don't remember how I finally arrived at Los Angeles and Pasadena. Then people would say go to the YMCA and get a room. Then I went to Caltech and see what they were suggesting. Finally I met a fellow called Leon Katz and we sort of got along well. So he said knew of a small two room apartment there, which we could share for \$5.50 a week. I said, "Okay." I didn't like California when I got there. It was a desert. The trees would only grow if you watered them, and we discussed that.

**Wilkins:**

You mean you like the wild growth of the trees.

**Bohm:**

Yes. Later I discovered they were growing wild in the mountains, but as far as you could see it was a desert. Mount Wilson had the lowest stubs that had apparently been burned off so it like quite as much as a desert. It was very hot for a while. But we got started with ??? Caltech and it was quite a different the atmosphere. First of all there were courses, we took an enormous number of courses and they gave problems to solve all the time.

**Wilkins:**

These were graduate studies.

**Bohm:**

Yes.

**Wilkins:**

Did you still have all the lectures?

**Bohm:**

Yes. We had lectures and also problems to solve and put on the board and so on.

**Wilkins:**

But you didn't in the first year or so do any actual research. Is that right?

**Bohm:**

No. On the first semester I was rather busy and not too unhappy. There was some sign that I wasn't going right. It wasn't what I had hoped it would be. There was a fellow there named Smythe [?] who taught a course in electricity and magnetism from his own book. It was just full of problems and we used

to solve them. I used to keep on trying to work out the theory of these problems and sort of talk about the work of this fellow Katz. But one day Smythe said to Katz, I wasn't there at the time, "I don't see why you fellows are bothering with the theories." He said, "This year you'll solve the problems and next year at this time we'll give a course on the theories."

**Wilkins:**

Einstein.

**Bohm:**

Epstein. There's a different there. I didn't think much of that. Instead of saying you just make me just right. Without knowing what you're doing you find a technique for solving problems and then you find out what you're doing.

**Wilkins:**

Very anti-educational. It's still quite that these tendencies still persist didn't it. Somehow you learn to use tools, but you don't know what the tools are or something. Very strange.

**Bohm:**

That sort of worried me, but that still was only the beginning. I remember in the mathematics course, it was a course in mathematical analysis. It wasn't as hard as Whittaker and Watson's book, but we found it quite interesting. There was only one thing that I can remember. There was a problem where you had to prove some theory about spheres. So I proved that by rotating the sphere, giving it a rotation and rotating the sphere in another direction, you know, rotating the sphere, rotating it again, rotating back in three steps. Instead somebody else had gone through a tremendous amount of trigonometry to prove the same thing. But I felt it was — what I wanted to do was see the answer directly rather than through a long process of calculation. That's something I've always tried to do. I don't trust a long process of calculation. There's too many chances of a mistake or a false assumption of something. We were kept quite busy. The one thing that had a profound effect on me, I picked up Eddington's book in the library there. The Relativity Theory of Electrons and Protons in which he claimed to make a complete theory of the universe that was completely defined and really captured my attention. I couldn't

understand what he had done there was so much mathematics.

**Wilkins:**

A modern counterpart of Euclid, you mean, in some absolute solution.

**Bohm:**

Yes. As mathematics was evidently a level beyond me, but what he said seemed very interesting and I tried to understand as much as I could. I tried to sort of write out some sort of nonmathematical version of the theory. I brought it over to Richard Tolman, he was a well-known physicist there, to discuss it. We discussed it and he said, “Well nobody could understand that [???] and it’s not clear there’s anything in it.” I was somewhat disappointed in the whole thing, but I sort of felt I’d made a fool of myself in getting so excited about. Then I wrote to this friend of mine at Penn State. We used to talk things over together. I trust him. I told him about it and he wrote back. He was a bit skeptical about anything, but the most striking statement I think he made in there was that he could deduce the nature of the reality unambiguously from epistemological

consideration alone. Now this fellow thought we had to do a skit on that or something. He said we had to write something on that [??] to the devil, you see. So he wrote it in part, but since that time I've gone over it again and again. There's a little [??] I've never written, which was a story went something like this, that making third [??] and Eddington, you see. So the idea was that Eddington was sitting in his study one night and suddenly he had a visitor with a beard and a long tail and so on. Eddington looked up and said, "Why — how did you get in?" So he says, "Well as a matter of fact I'm the devil." So he said, "What do you want from me?" Well the devil said, "We would like to buy your soul." And he said, "We're going to offer you everything. We'll offer you money, power, anything you want. We'll give you the works, everything." And Eddington thought for a while and said, "No." The devil was astonished. He said, "This is very surprising. Most scientists will sell their souls to me for something much smaller like a Navy contract or something, but we were offering you the whole works and you won't sell it. So, can you at least explain yourself?" Eddington said, "If you'll read my book *Relativity of Theory of Electrons and Protons* on page so and



so you'll see that I can deduce the nature of the universe unambiguously from epistemological considerations alone. If I wanted all those things I could have them." The devil had to admit that it was very logical. Then he said, "But we really need to understand your book. I've had my best scientist working on it and they can't understand it and we really have to understand it with this war with God. It's very urgent. What can we offer you just to help us with your book?" So the devil thought of all sorts of things. But finally the devil said, "Well can I offer you my soul?" Eddington says okay. That's provided you've just to explain your book to us and you can have my soul. So the devil gave him his soul and I think that he explained this book. So now if you want to understand Eddington's book you can go to the devil. That was sort of making fun of his claim of Eddington had gone too far.

**Wilkins:**

That was after the war began, so that was 1939.

**Bohm:**

Probably 1939 or early '40.

## Wilkins:

‘40, yes. Because I had an encounter with Eddington, which I may have told you about that in my college days of Cambridge as an undergraduate. I forget which year it was. Maybe it was the first or second year, possibly 1936. But he was giving a talk in one of the college rooms, just a room where some member of staff or presumably some college lecturer or someone had this as his study and the informal meeting was held there. Any undergraduate could go so I went along and we sat on the floor. At question time, I said this before, I asked him, “Professor Eddington, do you think that this working on this 137 and all of these?” I called them magic numbers, but the whole thing was somewhat mystical. This incredible conjuring trick that he was trying to put across and it made a great impression. He impressed me probably possibly in the same way he did you. So I asked him whether he thought this was the most important thing that a scientist like himself could be doing. Of course he said well, he wasn’t quite so sure of that thought. But it did, that Eddington stuff was put across in a sort of rather fantastic way, wasn’t it?

**Bohm:**

Well he sort of got something across. I think, although I realize it didn't make too much sense the way it was, but the aim sort of stuck anyway. Trying to make something in the universe and clearing up.

**Wilkins:**

He was a Quaker, a strange man. He had a very deprived life, too. I think he lived with his sister for a time. His main recreation was cycling by himself all over England. They found a map he had of England and he had practically every road, all of England sort of marked out where he'd cycle journeyed. He had drawn all over the whole thing. Strange solitary existence.

**Bohm:**

I remember I used to do a lot of cycling in Pasadena, but nothing to that extent. The roads were fairly empty at that time.

**Wilkins:**

Were they? Oh, the war I mean.

**Bohm:**

Yes. Well there weren't many cars there anyway.

**Wilkins:**

But they war made it emptier still, didn't it?

**Bohm:**

The war hadn't hit America yet. America wasn't in it.

**Wilkins:**

You mean when I was there, you mean there was no restriction on petrol in those days.

**Bohm:**

No.

**Wilkins:**

So there was less traffic anyway.

**Bohm:**

You could really walk on most of the roads and cycle.

**Wilkins:**

You see this thing — I mean, obviously the general principle is right, that strong deprivation or negative event in somebody's life can be taken in two ways. It can either be taken as a challenge, which one rises to and you do something very creative as a result of this so the negative taken in one's life becomes transformed into something positive. Or of course you can just wreck one's life. I wonder how many lives have created people there are in which one can point to possible negative situations, which have been transformed by the creative people? I mean I think the idea that placing people in harmonious surroundings where they are encouraged to be creative and so on and so forth. One might even say that this may, well that's what they've done, but I mean it could be quite destructive couldn't it.

**Bohm:**

Depends on whether it's really creative or not. I mean, I don't know if creativity requires this sort of deprivation, but probably it's one response to the

deprivation. Evidently Newton did. He had a very bad childhood. His father died very young and his mother married somebody else who had pushed him off on a foster father. Her new husband didn't want him. It was very disturbing to him. He had made a notebook when he was an adolescent, which was just for guilt and so on, the hatred for himself.

**Wilkins:**

So all the religious sort of feeling for the unity of God in the universe and universe of gravitation and all of that you mean could've been built up as a kind of reaction to all these splits.

**Bohm:**

It's an attempt to solve the problem of —

**Wilkins:**

Indirectly.

**Bohm:**

Indirectly. It's only a partial solution. Evidence is that about the age of somewhere in middle age

Newton became very depressed and was unable to work from there on and that's why he went into the mint. His friends got him a job in the mint. He was depressed precisely at the feeling that he was no longer creative.

### **Wilkins:**

Or maybe his existence was becoming too comfortable. I really ought to read something about Newton. Ratansi — you know Ratansi at University College, The Story of Science — he said he's writing a little book 80 pages or something like that. I met him at a meeting the other day and I said, "Jolly good. I think your little books are the best books." I think he doesn't find it easy to write a book. He hasn't really ever written one, except for The Story of Science, he tends to write books, he hasn't. But I think the interesting thing about Ratansi he starts off with Newton's religion and moves from that onto the science. It was very interesting to see what view he comes up with about Newton's science that way because it's normally quite the opposite way, isn't it? People start with the science.

### **Bohm:**

Anyway, one of the things that struck me about Caltech was the intense spirit of competition. They held exams every quarter. They were intensely competitive in the sense —

**Wilkins:**

Were people turned out if they did badly?

**Bohm:**

Yes, if they didn't do well. The whole spirit of the place was very competitive and it wasn't friendly really. I mean, I was a friend with this fellow Katz and we roomed together, but there was not a great many — there was only one other friend I really had and that was a Chinese fellow. Another point I should say was that I was fascinated by California as a place where one might meet another culture like the Chinese. Which I gravitate, not exactly, but I read enough to make me interested. The Chinese have sort of a reputation in America for being very clever and hardworking and settled. I also felt their culture was different over there. Picture of this sort



of very impressive and sort of aerobic mystic [inaudible].

**Wilkins:**

Had you heard about their holistic philosophy?

**Bohm:**

No I hadn't, but I sort of picked up something in what was said.

**Wilkins:**

You mean in other words their philosophy was somehow implied in other aspects of the culture.

**Bohm:**

Yes. And also possibly some of their pictures. Like the Chinese saying, "A picture is worth 10,000 words," or whatever it is. I found this fellow, Mao [?] his name was, and I used to say after studying during the evening I would walk over to his room for an hour or so and talking.

**Wilkins:**

Where did he come from?

**Bohm:**

Somewhere in China.

**Wilkins:**

So he came directly from China.

**Bohm:**

Yes.

**Wilkins:**

That must've been very interesting. Here's a real Chinese and he wasn't a Chinese American.

**Bohm:**

But he spoke English quite well. Naturally anybody able to do that was from the upper class, but we used to have long talks. Later when Katz left for the summer vacation I stayed a while longer. I took a room in this place. I rented a room in his house.

**Wilkins:**

In Mao's?

**Bohm:**

In the house he was rooming in. I remember once he cooked a meal there which didn't fairly agree with me at once. I told him let's go for a walk. I said, "Let's climb Mount Wilson." He asked me how far it was and I remember I said, "Oh, about 20 miles." So he said, "Okay." When we got there he said, "When is this going to end?" Apparently the Chinese man was thoroughly an Englishman. It took him awhile to get over that. I felt that it was important to come in contact with the different cultures. Probably that was a continuation of my childhood experiences with several different cultures. Here was a very strikingly different culture.

**Wilkins:**

Very interesting, I think, this thing about — presumably the Chinese who came to the United States were fairly exceptional people. As you say maybe they were reasonably well off economically, but presumably they had good educational backgrounds and family to take that sort of initiative.

**Bohm:**

He used to tell about how it was in China. I can't remember too much, but one thing was they would sit endlessly over meals eating a little bit at a time. They could spend a whole afternoon almost at one meal and be ready for the next one in an hour or two.

**Wilkins:**

Well what were they doing then?

**Bohm:**

Just talking and eating. It was a very —

**Wilkins:**

Talking and eating.

**Bohm:**

Yes. It was a very leisurely kind of life. It was very different from our Western life.

**Wilkins:**

I think in the United States coming from England I was particularly impressed by the high speed, this whole fast food or whatever it's called came from the states. I was impressed by the way in which the workshop people on the Manhattan Project ate their sandwiches sitting at their machine tools, at their lathes, in half an hour I think it was. It horrified me that, you know, it was like stoking up a boiler. It lacked any kind of cultural relaxation and then went back on the job again. Really, I see. I feel a bit happier about — Which parts of Europe? Hear about the current cultural educated Chinese people. Who were the two American Chinese? It wasn't the American Chinese who did the thing on parity.

**Bohm:**

No, it was Lee and Yang.

**Wilkins:**

Were they educated in the United States?

**Bohm:**

I don't recall. I think at least one of them was educated in China I think.

**Wilkins:**

I thought there was a quote from one of them saying that all this was pretty obvious because the Chinese thought differently about complementarity or something like that. I was never quite convinced whether this —

**Bohm:**

It's not clear, but they influenced that.

**Wilkins:**

I feel in many ways what people are afraid of Japanese science, too, but I mean the different cultural backgrounds of the Japanese don't seem to have affected the way in which they did science at all.

**Bohm:**

No. I think that having —

**Wilkins:**

It was completely Westernized.

**Bohm:**

Yes, but they adopted Western technology and have gone better.

**Wilkins:**

Found ways of thinking.

**Bohm:**

I think that it was inevitable to adopt that way of thinking and to adopt that technology. Anybody can adopt certain technology and use some levels. It takes the same way of thinking.

**Wilkins:**

You mean that the technology is somehow an expression of a philosophy to some extent and it tends to guide you.

**Bohm:**

Yes. They may have reserved their old way of thinking for various ceremonies and special occasions, but when that time comes to do a technology they don't see [???].

**Wilkins:**

I think the Japanese are very good at keeping certain cultural strands going in their lives quite separate from other aspects of their lives which are more Westernized.

**Bohm:**

I remember I was beginning to become a bit unhappy at Caltech. I got rather nervous at some of our exams. They kept giving one after another and I got worn down. I found out later, a few months later, they said they wouldn't give me an assistantship or a fellowship the following year.

**Wilkins:**

How many years had you been there?

**Bohm:**

Half a year.

**Wilkins:**

Only half a year.

**Bohm:**

Yes.



**Wilkins:**

But how long was your money for?

**Bohm:**

One year. I remember I was becoming a bit discouraged about the whole business. I used to take long walks up Mount Wilson to [inaudible]. The point was I wasn't really happy there at Caltech. The whole atmosphere of sitting around. They're not interested in science. They were more interested in competition and getting ahead and mastering techniques and so on. The whole teaching was directed that way. Apparently that was the dominant feature and probably had brought in people like Einstein as a [???].

**Wilkins:**

So they were really interested in techniques and not so much interested in the fundamentals of the science.

**Bohm:**

No, not at that time. Maybe they work like that now. But later on about a few months later I think after

the second set of exams and I did better, then they offered me an assistantship for the following year. But by that time I'd lost all my enthusiasm for the whole thing. In general I felt that what was going on there was not what I had thought I expected, would hope science would be. There was more like a business atmosphere that I had more or less rejected from the Wilkes-Barre. And possibly the thought come through my mind there was no point in having come this long way to go back to the same thing with less money than I could've had there. I think that sort of dampened me a great deal. I remember when I got back that summer, I went back to Wilkes-Barre. I didn't know all that much. I remember before going back while I was in that house where Mao was staying at I was very happy. I remember spending about three weeks studying [inaudible].

**Wilkins:**

You were working on your own.

**Bohm:**

Yes. Then I left and went to Wilkes-Barre. I think one of my friends, this Polish fellow, his mother commented I wasn't as bubbling as I had been

before. I felt somehow that I wasn't quite what I thought.

**Wilkins:**

When you were at Penn State, you mean you began to bubble again.

**Bohm:**

And also in high school and so on.

**Wilkins:**

In high school, yes. You mean you began to enjoy your work both at high school and at Penn State.

**Bohm:**

Yes. Now everything was more subdued and the feeling was that — I got the feeling that — I began to look at the whole set of American dreams and so on, you see — brought the whole West. I had the notion that the Orient had sort of gone through a very disciplined period and that they [???]. So I'd come into a philosophy which devalued activism because they were not allowed to take it real easy. So I said maybe the West is going through the same thing. It's going to enter the same thing. It really

looks like a mess, too. See the world is developing and — Let me think, now, that was 1940. 1940 was the invasion of France, wasn't it, and Holland?

**Wilkins:**

By the Germans, yes.

**Bohm:**

By the Germans. That also affected me a great deal to see them caving in like that. I felt the whole structure was collapsing. The British were holding up by the skin of their teeth and could do nothing. Apparently nothing could stop the Germans because I felt there was no will to resist. I felt that in America you had potential sympathy for Nazism and had a great deal of it. Because first of all nothing succeeds like success, and secondly there were a lot of people who were fascistically oriented. I could see that all this talk about freedom and free enterprise was not to be taken very seriously, that these people wanted freedom to make money for themselves and they didn't care what happened to

other people. They used very repressive measures against whoever. They created an atmosphere which was very conformist. I saw in Caltech this sort of atmosphere which was actually very tremendous pressure towards conformity and then being in competition for this conformity. People were too frightened to do other than try to conform. The people who talked about individualism and freedom were not individualistic. They were the most collective people I knew. They had no thoughts of their own. They were afraid to have them. They didn't want anybody to have them really. In general I was so disillusioned or disenchanted about the whole thing. Then probably I exaggerated it because of my own personal experience.

### **Wilkins:**

I suppose that physics was your big enthusiasm. Then you went to what was regarded as one of the best places for physics, a sort of pinnacle. You then found it was sort of pretty dreadful. It must've been a really frightful disillusionment. I suppose you might say it was like sometimes when we're climbing up a mountain. You would pass through a number of smaller, lower peaks, which are very fine

and you get very exciting views and want to go on further. You get up to the top of the peak, it sometimes turns out the view from the top is quite disappointing. I suppose in your case it was very disappointing.

**Bohm:**

It very disappointing, yes.

**Wilkins:**

That must've been dreadful. I knew one young man in Berkeley who was always talking about the things in the house where we were who had been at Caltech. He was not sort of limited thing, always yacking on about how wonderful Caltech was. I think one gets the feeling that it encouraged idolatry for established Caltech thinking. That was the impression that he gave. That it was a somewhat technocratic — I got [??] impression, but he couldn't —

**Bohm:**

It was really a very cynical environment. I remember students were very cynical of the undergraduates. They used to hold student elections, but they were just parodying these elections. Nobody would ever take them seriously. Caltech had a series of sub-basements, sub-sub-basements, sub-sub-sub-basements. You would go down, down, down. You finally get to the lowest sub-sub-basement. They held their political meetings down there smoking cigars making smoke filled rooms. Each candidate would often make absurd promises, obviously absurd promises, and then he would distribute cigars and condoms. Then in order to make fun of the whole thing they would show blue movies. I think the whole thing didn't impress me. I thought these people, what are they up to? They're so cynical about the whole structure of what they're doing why do they bother to do it? All they cared about was making money and getting ahead.

**Wilkins:**

Where are the higher values in physics, the universal harmony and [???] innovation?

**Bohm:**

These people were pouring scorn on the whole thing. The only thing that counts is making money and getting ahead in society.

**Wilkins:**

You're really pouring scorn on physics as such.

**Bohm:**

Not on physics, but on the whole political structure of America.

**Wilkins:**

The political structure, but they still had some degree of respects for physics in —

**Bohm:**

Yes. In rather their limited way in which they looked at it.

**Wilkins:**

Limited way. So they were still technologically, technically sort of fascinated. They like the puzzle solving and all the other scientific stuff.

**Bohm:**



And also they knew they would get ahead that way and make money and take care of traditional society.

**Wilkins:**

But of course there's a big element of that now throughout the whole world in physics, isn't there? It's not altogether like that, but this is a sort of a [??] emphasis.

**Bohm:**

But that meant to me primarily their total was going for all the values that America had stood for. I saw the businessmen are looking at it, they must pick it up. And parents and businessmen are looking at it that way. They don't believe in this stuff at all.

**Wilkins:**

But presumably part of course was due to the extraordinary power which the institute of Caltech had that everyone that was desperate to get on that ladder. The power I suppose and prestige of Caltech sort of destroyed the higher morality in the science they did there.

**Bohm:**

It sort of implied to me that this whole business, the whole mentality which must be characteristic of business as a whole, the power structure as a whole. The students didn't ??? them for themselves. Therefore it's the gestures and the tremendous cynicism which was current in America and that that way they could quite readily offer fascism if it were successful.

**Wilkins:**

That sort of free enterprise society could move into fascism without too much difficulty. And also you mean that you felt that science at least had a better aspect to it in which one would be encouraged to do the work, return and creative sort of emphasis.

**Bohm:**

But there was no time for creativity there. They were just competing, solving problems, and working out techniques. In fact, if you tried then the teacher said next year you'll get it in theory and that theory you just go get it. There was no creativity there either.

**Wilkins:**

In fact you can say if you're in a good creative atmosphere in science you will be — naturally tend to be led into somewhat more creative ways of working whereas in this place it was the opposite. I suppose you could see that there were certain outstanding laboratories. I think the Cavendish laboratory and —

**Bohm:**

I didn't know too much about them. I knew that the [??] was an outstanding place.

**Wilkins:**

I think there have been, well Bohr's lab, I suppose, is another one where people have maintained that a scientist of a certain sort of general quality game there would achieve very much more than if he went to some other laboratory which didn't have that special quality. But you say that in Caltech the special quality was one that was sort of go get up the ladder, cynical business type.

**Bohm:**

Yes, that was the general quality and people were of course into it. I did get this assistantship for the second year and I had to stay in a place called the Atheium. It was a — once a week there I had a room, some sort of little dormitory. I wasn't happy there and people could see that. I remember once we went out for a walk in the mountains at Mount Wilson and I came back quite happy. See the fellow who was sort of the administrative head sort of commented on it to me. He said, "You're always looking so unhappy. The first time I've seen you coming back from the mountains and you look away." That is he was sort of annoyed that a person should go around there with actually going in there with such a —

**Wilkins:**

You should be glad to be in Caltech, you mean.

**Bohm:**

Yes. Then I tried to find somebody to work, but Rhea and Epstein were the only theoretic—

**Wilkins:**

Was that to do a Ph.D.?

**Bohm:**

Yes. We never hit it off. He proposed a problem which consisted of trying to calculate the scattering of light from a nebular, from some sort of gas cloud. I kept on trying to find an analytical way of doing it because the thing was a dreary business if you just had to complete it. Nothing very interesting, so for several months I tried to find analytical expression and couldn't succeed. That's when I met this fellow, this relative of mine called Milton Plessner. He's a very distant cousin on my mother's side. He was there for a year. We used to talk about this problem and trying to find an analytical solution.

**Wilkins:**

He was doing physics as well?

**Bohm:**

He was there for a year. He was already beginning to go into medical physics. But finally I couldn't get on with that. I mean, there was nothing for it but to slug it out with a computer. It was computation. I didn't see the point of doing it, you see, and the?

**Wilkins:**

Which means you didn't have computers and it was sort of an extremely laborious configuration.

**Bohm:**

Yes. But it seemed pointless. I mean, I said why should I, you know, be able to calculate this thing out and then someone's going on to use my results, but that really wasn't what I wanted to do in physics. I didn't get on with it, and then actually they didn't offer me anything next time. But I remember doing more and more, just more reading at the library and walking up the mountain. I used to climb Mount Wilson about twice a week. In general I was getting a little bit, not exactly depressed, but probably a little low. But then I talked with this fellow in Oakland Press. He said, "Look, you should try Oppenheimer [?]. You know Oppenheimer comes down every now and then to Caltech for a little while."

**Wilkins:**

Where was he based?

**Bohm:**

At Berkeley. He said Plesser knew Oppenheimer. He says well I'll introduce you. So when Oppenheimer came down we were introduced and it was suggested I'd like to go up there. And he said, "Okay. We'll see what we can do." So when mid-term was over at Caltech I moved up to Berkeley. I didn't know really what was going to happen so I stayed in the YMCA while Oppenheimer was waiting to see if he could arrange something. But after a little while, I can't remember how long, but he came to me and said okay, fine. That's how I started up in Berkeley.

**Wilkins:**

Were you doing some sort of job?

**Bohm:**

Assistantship, the assistantship. It used to pay like \$500 - \$600 a year. It was less than I had when I had whenever I fellowshipped, but the standard assistantship.

**Wilkins:**

Enough to live on.

**Bohm:**

Yes, not really all that, necessarily, but we got enough to eat, anyway. I didn't need much in the way of anything else in the time of this. Anyway, so when I got started, let's see that was '41 wasn't it. Yes. So I got started in Oppenheimer's group and got along better. But in general this whole Caltech thing had finally gotten me down about physics, but I probably still had the idea that perhaps it was only Caltech, that other places might be a lot better. I think it had a profound effect on me about the whole, not only the American dream, but the whole possibility of improving society. More and more as I went through college I used to think about a better society. I felt somehow this society was not a good stopping point, that I used to think somehow there would have to be a better one, and I used to like to talk about it to whoever would want to. In the end it sort of produced a better [???]. I remember there was one fellow I used to talk about these things like Caltech and a second year Quaker and we used to talk together about it. I began to feel it had a hollow ring. It no longer looked plausible. I could see the nature of the society so clearly there in Caltech and Pasadena.

**Wilkins:**



You thought the Quaker was being a big unrealistic.

**Bohm:**

Well, so was I. We both were being unrealistic and just trying to cheer ourselves up with dreams.

**Wilkins:**

What was the problem you were working on with Oppenheimer?

**Bohm:**

That came later. I'll have to explain that. Anyway I suppose I had reached a stage where I didn't, you know, I'd seen the collapse of Europe in front of the Nazis and the possibility of fascism marked with a cynicism and money centered most of the goals of society. I think it had the effect of greatly weakening the kind of youth side of one's health about the whole situation. I sort of couldn't quite see where things were going. You know, I had this notion of people like the Orient, people would [???]. Sort of give up when nothing could be done. The

Depression obviously was still continuing although the war industry was good and going. Then I got up to Berkeley. From there first of all Oppenheimer's group they were much more lively. They had a real interest and even had an interest in science as such.

**Wilkins:**

Less competitive?

**Bohm:**

Yes. We really didn't have a great deal of that competition there. Also I very much liked the whole nature, you know, just to be able to walk the hill there up to the Grizzly Peak in that area.

**Wilkins:**

Natural surrounds are much nicer.

**Bohm:**

Yes, they're much nicer than Pasadena. In fact they were the most beautiful I had seen so far and being able to look over the bay and from [??] and the

bridge and all of that. I hadn't had that in Pasadena. I had to go all the way to Mount Wilson to get that and that's a long walk.

**Wilkins:**

You mean in Berkeley you were so to speak a bit on top of a peak all the time.

**Bohm:**

Yes. Or you could just walk up a little way and you would already be overlooking the bay.

**Wilkins:**

Yes, I'm certainly very glad I went there and not to the Los Angeles region. The natural environment as well as the cultural one was different.

**Bohm:**

And he held seminars, Oppenheimer, like once a week or twice a week. Everybody would participate and people gave talks and everybody talked about it. One night there were people that could maybe talk about physics. So the whole thing went in a more

lively way and I began to read on my own. I thought I would take some courses although I didn't find any of interest. I went to Oppenheimer's course in auto mechanics, but most of the others came in at a lower level than those I already had. The courses were fairly high level at Caltech and I'd studied quite a bit at Penn State. Technically they were in a high level. People talked about all sorts of things and politics and other things. It seemed a more lively environment and also it was cooler, which I sort of found oppressive, that area often much too hot. As I said, I can't remember what the order of things was. Oppenheimer suggested a problem, which I shared with somebody else there, another fellow who wasn't that competent. It consisted of trying to compute the scattering of protons from deuterons. We were looking up all sorts of ways of doing it. I remember we had to read a paper by Massey and Hokenen [?] and we couldn't make sense of it. It made some sort of mid-calculation of it, plus it didn't make sense. I don't think we ever did make sense of it. It may have been right or wrong, I don't know, but I had the feeling we made some distinction between using isotropic spin [?] and not using it, though I can't remember it. I got on with it.

We had to make a lot of approximations to be able to do anything with this thing. We worked on it and we got it as far as we could. I think I was reasonably happy there. But I remember December 7th, 1941 I came back from a walk up the hill and I saw in the paper the war impending there.

**Wilkins:**

Was it the United States entering the war?

**Bohm:**

That's right.

**Wilkins:**

Where was Pearl Harbor then?

**Bohm:**

That was Pearl Harbor, December 7th.

**Wilkins:**

It was all done in one day, wasn't it?

**Bohm:**

Yes. It probably had been building up, but I hadn't picked it up because I was sort of too busy with physics. I mean, I knew war was likely, but I hadn't been watching it that closely. In general I felt it would probably be necessary, otherwise Hitler would never be stopped.

**Wilkins:**

Incidentally, have you ever read the history the Pearl Harbor business? It's incredible the number of warnings that the Commander at Pearl Harbor was given that the Japanese were planning to attack.

**Bohm:**

Yes. There is a story that Roosevelt ignored the warnings on purpose because he wanted to bring the country into the war and I think there's a good chance that it's true. You see there was a lot of opposition to going into the war, not so much from the peace movement as from the more right wing people, you see. There were quite a few Germans around that were somewhat favorable to Hitler and

the Hitler German ancestors. It was primarily on the East Coast the people who had this English background that were more interested in helping. It was kind of a potential split there.

**Wilkins:**

I think the Japanese said the same thing that they were set up, so to speak, lured into the —

**Bohm:**

Yes, into attacking us. So, because I think Roosevelt was clear that for six months that Roosevelt was [???] a policy of intervention as far as he could. He wasn't making [???] sending help on the ships across the Atlantic and so on. I mean, he was obviously taking every step short of war. On the whole I felt that from the point of view of logic that it was necessary to do this.

**Wilkins:**

Unavoidable.

**Bohm:**

But I was a little worried about the whole idea of war busting out, so I had another [inaudible].

**Wilkins:**

When did you hear about the Manhattan Project first?

**Bohm:**

I don't think I'd heard about it at that time. I heard about that a bit later. In the beginning we sort of kept on with our work, but Oppenheimer became more and more involved in war work, harder to get a hold of. I can't remember whether it was before or after, you see I had been working on this problem for a while. He asked me to give a seminar to the whole physics department and so I gave this and I prepared it very intensively for two weeks. I gave the seminar and it went extremely well. I could tell it was going well. I could feel a sort of contact with all the people there. I felt tremendous elation. Afterwards everybody came up and said how good it was and they kept talking about it. Even for several days they'd comment. But basically the problem for me, I think it must've been several months after the war was declared. It created a problem for me. I felt



putting so much energy into this preparation it had built up to a tremendous pitch of energy and it seemed to build up again in that seminar to a pitch that I'd never seen before. Suddenly it was kind of a letdown. It was almost a transformation of the mind sent to another order.

**Wilkins:**

You mean having reached this peak and you come down the other side and you don't know what to do then.

**Bohm:**

Yes. It was sort of a letdown, so everything was ordinary and stupid. I even said what was the point of all these people saying how wonderful it was because it was all pretty [??] now. Also, I began to look at all the calculations and so on and I could see that they were full of holes and that I'd sort of anchored much to a vital picture. I sort of got a tremendous let down that gave me a depression.

**Wilkins:**

It didn't lead anywhere then.

**Bohm:**

No. That affected me for about a year. It was hard for me to get on with any work and I didn't get on with the research or with passing exams for the Ph.D. I think Oppenheimer was becoming very discouraged about me.

**Wilkins:**

Do you mean he wasn't really paying much attention to your work anyway. I mean, he was involved in other things.

**Bohm:**

You're right, he couldn't. He taught very well at that time. In fact he took what I was doing as a reproach to him for having suggested this problem, which didn't have so much in it. Nothing could be done with it that it required such approximations that you couldn't roll up in a — In other words, it was something just doing the calculation at that point and whether the approximations were meaning anything.

**Wilkins:**

You mean that he felt that your work and your reaction to these calculations exposed him as having chosen a rather sterile study.

**Bohm:**

Yes. So he was a bit apologetic.

**Wilkins:**

Well that at least was sort of a decent reaction where some people would've just taken it out on you having showed their mark or something — blame few for not having done a proper job.

**Bohm:**

Oppenheimer was a peculiar fellow. At times he could be very generous and very good and other times he was quite the opposite, very nasty.

**Wilkins:**

It has been said that he felt frustrated because he had a lot of great talent, but he never really achieved anything.

## Bohm:

No, not at all. The first thing I heard about him was from Plessett who said exactly that, that people were divided. When he came back from Germany in '32, they regarded [??] American Physics. But then he never really achieved very much for himself. He was really best as somebody who inspired others in the school to work. I think he became discouraged about it. He took up Sanskrit. He became interested in politics, [??] politics. I think all is a way of trying to achieve something great. There's an interesting conversation that Weinberg had with an actor (Jill Weinberg) after he joined and after it was clear he was in this Manhattan Project. They were talking together and Oppenheimer had said that he wanted to influence history. He felt that he would try physics, it didn't work. He tried in politics, it didn't work. Now he tried it here in the Manhattan Project and maybe it would work. See he gave the impression of being far more brilliant than he was. He was very good. He had tremendous charisma and he built a [??] he impressed people so much they thought something wonderful was going on. When you analyzed it, it wasn't that much. For example, this fellow Richard Tobin [?] was a very good

physicist. He used to worship Oppenheimer. He said if Oppenheimer were studying a physics book and doing something else at the same time and busy doing something else at same time and so on. It was just he studied with somebody else. There were people around him who really worshipped him, regarded him as extraordinary. And he sort of played the role. On the other hand he could turn very nasty and become very scathing and sarcastic, which he did sometimes in his seminars. Many of the people were afraid of him.

**Wilkins:**

Do you think that he was taking it out on other people because he felt unhappy about himself?

**Bohm:**

Well that may be. It came out later that when he was a child his parents had expected great things of him, tremendous things because he was so bright. And he didn't feel that he could do it and he used to walk on the shore of the beach there where he lives and he would "[??] himself out" because he couldn't make it.

**Wilkins:**

How dreadful these pressures that parents — I was afraid the parents thought they were encouraging him.

**Bohm:**

Yes. Well they weren't sort of German immigrant parents. They were quite wealthy. So he had independent means.

**Wilkins:**

Trying to ensure they did the best for him.

**Bohm:**

Well, he used to hold parties and song, which were supposed to be fabulous. I only managed to get to one before he left. None of those things really impressed me, but by that time he'd gotten married and so on. He used to hold parties where he'd invite the physics department and a lot of other people of sorts. He would begin with everybody with a very

large glass of scotch, I remember, then traditionally end with Beethoven's C Sharp — Quartet in C Sharp Minor.

**Wilkins:**

Who would play that?

**Bohm:**

The piano guy. I think to some extent it was kind of an expectation and culture, but it was sort of a fabled sort of thing.

**Wilkins:**

You mean in a normal sort of accepted range of cultural appreciation.

**Bohm:**

Yes. He also Sanskrit, but apparently some of those who knew Sanskrit could say he wasn't extraordinary in that. He was extraordinary enough to impress other people with his knowledge. But he could pick things up very fast. He could pick up the

essence of a situation very fast in physics or somewhere.

**Wilkins:**

Well he was learning the Sanskrit so he could read Indian philosophy.

**Bohm:**

Yes.

**Wilkins:**

And poetry I suppose.

**Bohm:**

And poetry and so on, I guess.

**Wilkins:**

It's sort of a hippie tendency beginning to show itself.

**Bohm:**

But the whole atmosphere was stimulating, anyway.

**Wilkins:**



You mean there were lots of ideas, political ideas, philosophical ideas as well as physics.

**Bohm:**

Yes. There was a group of a number of people who used to talk politics and philosophy together.

Weinberg was one of them. He was sort of a person who was very good at mathematics, at doing special mathematical techniques and so on. He had a very sharp precise mind. I felt that although he was very stimulating finally he was just sort of wearing me out. I would get so tired of him because I felt that [???] always sharp precision went nowhere. He defined issues so sharply that it seemed as if it just absolutely must be that way, but it was overlooking [???] things.

**Wilkins:**

You mean there was too much emphasis on the intellect as distinct from a more sort of general feeling, physical truth.

**Bohm:**

Totally feeling. And tell it to fit under the sand because it's a politics.

**Wilkins:**

Yes, the same type of mind.

**Bohm:**

He saw things in such sharp categories.

**Wilkins:**

You mean everything was capable of definition, his part of it you mean.

**Bohm:**

Yes. Is there very much left?

**Wilkins:**

No, there's not very much left.

**Bohm:**

It makes time also have to go into the politics, you know, philosophy because that sort of led to a lot of what followed later.

**Wilkins:**

I was just thinking if I look at my watch I realize if I go quickly I can just catch a train, otherwise it'll be one track half an hour. Shall we do that?

**Bohm:**

Yes. Well, I'll just introduce it by repeating again that — Saral — I listened to this with Saral and she felt that I wasn't getting a fair picture of my relations with Oppenheimer and my feeling for him in the early days that was distorted by the negative feelings that came later. And that really we should go over this and try to make it more objective.

**Wilkins:**

Yes, well, what were your feelings at the time about Oppenheimer?

**Bohm:**

When I first arrived I felt a great admiration for him and he was a very stimulating person. He could make one feel tremendous interest in things, that things are very worth doing and very worth — everything he talked about seemed to be exciting and interesting. And other people felt the same. I could see that. In fact, I could see some people were

practically worshipping him. I could see that was going too far. But I think that nevertheless I had a lot of affection for him and admiration for him. I think he was taking the role for most of the people in this seminar (in fact, in a much larger sphere than that in the university) as a kind of father figure who would be a kind of ideal father who would be very helpful and very interesting and very sympathetic.

**Wilkins:**

Stimulating.

**Bohm:**

Stimulating and helpful. Stimulating and also helpful in trying to do his best for his children.

**Wilkins:**

Yes, I think.

**Bohm:**

Having their welfare at heart and so on. At the same time, some people had an absurd degree of worship for him. Like Richard Tolman (I had mentioned him

before), who felt that he could be doing four or five different things at once and then doing physics at the same time and he would be about equal to any other physicist at that point. I could see that there were a few other people who sort of worshiped him, not quite so extravagantly, but I could see that there was some distortion going on. But in the whole, I went on along with it a little bit perhaps. Probably partly because you're — it seems obvious that perhaps there was, at the back of my mind, the notion that he was going to fulfill the role of the father, which was not fulfilled.

**Wilkins:**

In your own personal case and probably to some extent in other people's cases, too.

**Bohm:**

Yes, that's right. Probably nobody's father really was quite right.

**Wilkins:**

Yes, to one's hopes, yes.

**Bohm:**

With my father, as you know, there were many difficult problems and he often discouraged me and made fun of what I was doing and he wanted me to do something else, really. Here was somebody who would encourage me and appreciate what I was doing and try to help in any way he could. And at the same time he was a very intelligent and capable person full of energy and vivacity and ideas. His seminars were always lively.

**Wilkins:**

What do you think he felt about these people who seemed almost to worship him? Do you think he encouraged this?

**Bohm:**

Well, I think he had an ambivalent attitude toward it. In some sense he liked it, but in another sense he could see through it. He felt he didn't like it. He

wanted to be worshiped in so subtle a way that it would not appear —

**Wilkins:**

Even be aware of it. Yes, I know, yes, yes. He would like to be worshiped, but he would like to retain his humility at the same time.

**Bohm:**

Yes, or at least give all the appearance of that. He didn't give the appearance of being proud at first. It seems he would come in talking with you on an equal basis and so on. It seemed very different from some other professors. In one sense, I think this was genuine on his part. It wasn't that he was putting it on.

**Wilkins:**

Now, he came from a German background.

**Bohm:**

A German-Jewish background.

**Wilkins:**

Well, what age was he left Germany?

**Bohm:**

No, he never — his parents came from Germany. He was born in America, New York.

**Wilkins:**

I see. Because this nonhierarchical attitude would have been a little difficult to expect if he had been brought up in the German educational system, wouldn't it?

**Bohm:**

Yes. No, I think that he was clearly showing American background there. Also, I told you last time that he had a very difficult childhood. He was very bright and his parents expected him to be a genius. He felt he could never fulfill these expectations. He writes that he once walked on the beach and felt like rubbing himself out.

**Wilkins:**

He said that?



**Bohm:**

Yes, that's written somewhere.

**Wilkins:**

Oh, I see, but he never spoke about that?

**Bohm:**

Not to me, but I've read it somewhere.

**Wilkins:**

Yes, yes.

**Bohm:**

So evidently his whole life was like that. People around him had tremendous expectations, which he never quite fulfilled. When he went to Germany to study under Borin [?], he came back with a glowing reputation and they felt there had never been — now at last it would be a good American theoretical physicist. That was the sort of feeling in the circles there in America.

**Wilkins:**

They felt in real need, you mean, of somebody better?

**Bohm:**

Well, Americans felt that they were okay on experiment, but they were very weak on theory, you see.

**Wilkins:**

I see, oh.

**Bohm:**

In those days it was probably true.

**Wilkins:**

I see. And they had lots of people like Lawrence and so on.

**Bohm:**

Well, they had a few any way. They weren't really exceptional. The Europeans really were, on the whole, far ahead of them in physics at that time. They were more connected with industry and practical things. Things going on in Bell Telephone

Labs. Somebody like Langmuir, for example. That would be more like the American type.

**Wilkins:**

Yes, you mean the good science sort of sprang out of the practical problem solving work?

**Bohm:**

Yes, or Milliken, Michaelson, Morley. Gibbs — the only really great American theoretical physicist had been Gibbs.

**Wilkins:**

You mean he was very much an exception you mean?

**Bohm:**

Yes. So I think that they keenly felt that they were behind the Europeans, and they thought here was somebody brilliant enough to get the American physics out of that situation. So therefore, he was the great hope of American physics, as this fellow Placit

[?] had told me. For several years it was hoped he would be that way. He came to Berkeley and everybody expected it of him. He had the personality and the charisma and the whole manner and everything, which would back that up. But he did not do a great deal of original work. He did manage, during that period, to set up a school, which inspired — a lot of good people came out of it.

**Wilkins:**

You mean the school in the university of physics?

**Bohm:**

That's it. Theoretical physics.

**Wilkins:**

University school?

**Bohm:**

Yes, it was really essentially a leading theoretical physics group in America. People like Schwinger [?] and a lot of other people came out of it. Serber [?]. There was a whole bunch of people. These people then went out and taught so it probably had a big effect. You could say that he inspired that, but his

own achievements were not up to what people would have expected. As I said before, he got interested in Indian philosophy, and to do that he studied Sanskrit. I could never judge any of that, but I've heard some people say that his knowledge for Sanskrit was all right, but not that great. In other words, it was not an exceptional sense, great scholar or something like that, but he probably was good enough to read the Vedas and things, the original, and he evidently had a great interest in the Vedas.

**Wilkins:**

Did he have a very quick intelligence?

**Bohm:**

Very, very fast. He could see the essence of a point very, very quickly. So that was another thing which impressed me very, very much.

**Wilkins:**

Do you think he was able to see a really profound meaning in things or did he go down sort of ninety percent of the way and very quickly —

**Bohm:**

Well, I think he saw things pretty profoundly at times. The difficulty was that he didn't have a lot of capacity for — he could see what other people were seeing, the essence of it, even when it was profound. He could appreciate that propensity.

**Wilkins:**

He could operate at all levels of the profundity?

**Bohm:**

Yes, but somehow, I don't think he produced anything profound himself.

**Wilkins:**

Yes, and you don't know why this was?

**Bohm:**

No. You see, at that time I really had a lot of affection for him, almost love you would say and everybody around him felt that way in that group. Others must have been far more than me, you see, because kind of the worship they had.

**Wilkins:**

Yes. But last time you said something about sometimes you feel agnostic. I mean, that was what you think sort of you saw this more in hindsight?

**Bohm:**

Yes, more in hindsight. Well, he was seldom nasty with me, you see, but he was sometimes nasty in a seminar with people and if he disagreed he would say things were stupid. He would really get very nasty. And Serber, I saw him on a program on TV saying that many of the students were terrified of him. They were almost afraid to talk.

**Wilkins:**

I wonder if he might have picked this up from the American background. Because Delbrück apparently used to do this sort of thing. And he was of course brought up and educated in Germany as a theorist or

physicist and I think he had the tradition, but believed that it was a very good thing in discussion. You could be absolutely ruthless in chopping to pieces anyone who had silly ideas.

**Bohm:**

Well, I think Oppenheimer may have looked at it that way. Saying that here's somebody with a silly idea. Let's chop it down. Let's chop it down right now. At the same time there was a little bit of trouble. I didn't see it at the time, but there was probably a little bit of animosity in there. Not maybe chop down the idea, but put this idiot in his place.

**Wilkins:**

Yes, you mean that one might still sort of be able to encourage the person without —

**Bohm:**

Without making it personal. Saying here is an idea that's wrong, but I'm not going to imply you're an idiot.



**Wilkins:**

Yes, yes. You can always say, well, yes, this is a very interesting idea. It's a good thing you brought it up, but let's look at it.

**Bohm:**

Let's look at it and solve it together. It has its attractive points.

**Wilkins:**

And soon the person who put it forward more or less sees himself valueless. Yes, quite.

**Bohm:**

But see, Oppenheimer couldn't resist the wish to triumph over idiocy. Perhaps he was once — he must have been frustrated in the sense he was so quick and other people were often so slow. He really could see a lot of things very fast. He felt he could see, perhaps, more than he really could.

**Wilkins:**

Yes, he may have been very frustrated that he couldn't turn these special abilities to some more effective purpose in doing something.

**Bohm:**

He felt these idiots were just blocking him. And later on when he did this with powerful military people this was a very dangerous thing to do.

**Wilkins:**

Oh, he did it to them did he?

**Bohm:**

Yes.

**Wilkins:**

Oh, God.

**Bohm:**

Admiral Strauss, you remember — Strauss they called him. He was the head of the AEC or something and Atomic Energy Commission. He was

a physicist, but he apparently didn't know a lot, but he sort of really swept the floor with him.

**Wilkins:**

This may have added to the whole —

**Bohm:**

Oh, I'm sure it did. One idea is that Strauss was the main man behind all the trouble.

**Wilkins:**

Interesting point there. You mean it just wasn't pure McCarthyism. It had personal elements for getting him.

**Bohm:**

Well, some people just plain wanted to get him, and once they set that process in motion then the McCarthyist environment provided the machinery to do it.

**Wilkins:**

Eventually, I've got some book at home about Oppenheimer. I forget what it is. Maybe it's got letters. Maybe you'd be interested —

**Bohm:**

Yes, I probably would be.

**Wilkins:**

It's a new book, which came out recently. I mean, I got the general impression just by reading old things here and there that he was really a bit sort of mixed up somehow. That he didn't have any fundamental clarity of vision.

**Bohm:**

Well, I wouldn't — I don't think that's quite fair, you see. No, he was very, very clear and sharp and perceptive in certain ways. Especially his ability to listen to somebody else and see exactly the meaning of what that person was saying.

**Wilkins:**

Yes, but was he able to put all these small bits and meanings, so to speak, in a sort of a bigger overall scheme?

**Bohm:**

Well, he didn't put it himself, but for example when he was running Los Alamos, all the people there agreed that he had a hold in this tremendous complex operation at his fingertips. He knew exactly —

**Wilkins:**

Yes, well it was all operating on one sort of level wasn't it?

**Bohm:**

Yes.

**Wilkins:**

Scientific, technical job to be pushed forward. I mean, well, it seems to me, and of course I knew nothing about it, was that when he got the relating of the scientific and technological to the moral and philosophical questions he seemed to —

**Bohm:**

I don't think he could bring it all together at that level. He was trying to. He probably didn't manage it.

**Wilkins:**

This is where I got the feeling that all this sort of communism and philosophy and everything that he was finally — he wasn't very good at sort of connecting it all up. Why did he get in such a silly mess as he did finally?

**Bohm:**

Yes, I don't know. See, I had the feeling that he somehow was — well, perhaps, this may have been just a feeling, but he was somehow not going all the way with what he was doing. You see, he would sort of hold himself back in some funny way. But that's — I mean, I can't quite —

**Wilkins:**

Yes, well, what you mean is that he may have lacked the ability to go the whole way and really get his feet on the ground in the broader sense of science and morality sort of overall. He was sort of not quite getting down to rock bottom and therefore he —

someone like that is very clever is likely to become a bit unstable.

**Bohm:**

Well, I would rather put it the other way. That he wouldn't rise to the greatest heights.

**Wilkins:**

It's all right. Put your feet on the ceiling, you reach for the ground.

**Bohm:**

He wouldn't climb the highest peaks, you see. That he would sort of somehow stop somewhere in the middle.

**Wilkins:**

But also, you might say the only way of operating in such areas is to be able to reach right to the top so that you reach some sort of ultimate kind of Godlike kind of principle.

**Bohm:**

Well, that's what he wanted to do. In fact, that's what he was giving the impression that he was doing to other people.

**Wilkins:**

But you feel that he did sort of lack the ability to reach the last ten percent?

**Bohm:**

Yes, and I think, that's not an intrinsic lack of ability, but somehow it was almost a matter of his own principle that he wouldn't do it. But see, I don't know why.

**Wilkins:**

Yes, you mean it could be kind of an obsessional neurosis thing that he —

**Bohm:**

Yes, he mustn't do it.

**Wilkins:**

And so he held himself back a bit.

**Bohm:**



Yes, he was perhaps afraid to do it. Perhaps going back to his childhood. This was too much to expect of him.

**Wilkins:**

I would have thought that was quite a reasonable kind of thing that he was afraid to demonstrate how much ability he really had. Because I suppose if you really tried to demonstrate your abilities one hundred percent you would then have to face the risk that maybe they weren't as good as you thought they were. So you always — I mean, I've known research workers like this that deliberately hold themselves back and do secondary hum-drum work all the time precisely because they don't want to take the risk of doing anything ambitious because they then might have to face the fact that they weren't as intelligent as they like to think.

**Bohm:**

Well, somehow it's hard to know why he didn't come out with original ideas. I think he had this background? he was expected by his parents and by American physicists, this situation constantly

reoccurring, expected by people to perform something wonderful.

**Wilkins:**

That's a pretty difficult way to grow up.

**Bohm:**

Then somehow he tried it and it wasn't quite wonderful enough and he, at some stage, he sort of concluded I'm not going to ever be able to do this. I'd better try to bring it out of other people or perhaps I'll study Sanskrit or perhaps I'll become — he probably had to do something great, world shaking, and so on. Perhaps I'll do it in politics. At a certain stage, see, it wasn't he went in for politics on the left. Obviously, there was very good reason to go in the sense that a critical situation was developing. Fascism was winning in Europe and Spain and so on. There was danger of war. So that it wasn't just a purely subjective question. But he went into politics quite far to the left. His brother was known to be a member of the communist party. I don't know whether he was or not.

**Wilkins:**

Frank?

**Bohm:**

Frank, yes.

**Wilkins:**

Because I met Frank a bit a few times in Berkeley. He was there when I was there.

**Bohm:**

Yes, I met him a few times, too. But it was never clear how far Oppenheimer had gone, but he was quite far to the left. He had the same charisma in politics that he had in everything else he did. I unfortunately had very little contact with him on those issues. I never talked with him about it. I could only know what other people said.

**Wilkins:**

Why was that?

**Bohm:**

There was very little chance, first of all, because I came to Berkeley about June of 1941 and December came America entering the war and not long after

that he began to get involved in war work. In addition, he seemed to be reticent about discussing these things with me. Or, perhaps I was with him. I don't know. Somehow I picked up he didn't really want to talk about it with me. At least that was my impression.

**Wilkins:**

Well, presumably this political work you mentioned was more in the nature of intellectual discussion.

**Bohm:**

Well, I really don't — it's not known what it was. He may have attended meetings of the Communist Party and talked with them about different things.

**Wilkins:**

This would be discussion. I mean, he wasn't the icon public platform.

**Bohm:**

No, I don't think so. Not that I know of. I think that he must have inspired some of the students to left

wing activities. See, I came just about the end of the whole era where a lot of them had left and only a few remained.

**Wilkins:**

Where had they gone?

**Bohm:**

Well, they had gone out for jobs. They had finished their degrees, post graduate work, and their post-doctoral work, whatever they were doing. And there were still a fair sized seminar, but some of the best ones which had most interest and gone. So anyway, when I got to Berkeley I got out of this miasma, which I'd been in Caltech and I began to — I felt much more active and energetic, you see, as soon as I arrived at Berkeley. The climate was better for me, too. Then there were the hills of the back, which I used to walk in and revive my spirit whenever I got down.

**Wilkins:**

What on the hills was it that enlightened your spirit?

**Bohm:**

It was the whole beauty of the whole thing. The hills, the bay, the bridge, the Golden Gate Bridge. The nature, the trees, climbing up the Grizzly Peak.

**Wilkins:**

The general just? it was also the trees growing themselves.

**Bohm:**

Yes, everything. Berkeley itself was a rather ugly city. Not nearly as nice either as State College where I had been or Pasadena. But these hills made up for it. The point is there was — I was staying in a house there where various people were staying, rooms. Next door to me was a couple who lived there and the woman was — there was a road that went up toward Grizzly Peak or up from Strawberry Canyon, and she called it Storybrook Road.

**Wilkins:**

It went up beyond the Strawberry Canyon?

**Bohm:**

Well, you climbed up beyond Strawberry Canyon. You got up to a road. It was the top of the panoramic —

**Wilkins:**

Yes, there wasn't a road going beyond the Cyclotron [?].

**Bohm:**

Well, the Cyclotron didn't have — no, there was no road then at all beyond the Cyclotron. No. It went up beyond Panoramic Way and got onto a higher road, which sort of circled around toward Grizzly Peak.

**Wilkins:**

How far, roughly, was Grizzly Peak?

**Bohm:**

Well, a few miles I suppose. I don't know. It was about 1800 feet. And there you could get a view of the bay and also look the other way toward Mount Diablo and the land. This woman used to call that

road Storybrook Road that is that like in the storybooks of childhood, a fairyland.

**Wilkins:**

I see, along the tops of the hills.

**Bohm:**

Moving around. Not to the very top, but the road which sort of climbed up down there. So I think that greatly revived my spirit to be able to do that. And also, the whole environment and the seminars around Oppenheimer was stimulating.

**Wilkins:**

Yes, well what is this thing about the story?

**Bohm:**

Storybook Road. Like a magic road —

**Wilkins:**

Ah, that's the word I was after, magic. Magic, mysterious, but he's magic, yes. So, it's somehow out of this world.



**Bohm:**

Yes.

**Wilkins:**

Which has a special quality. I think it was interesting when I raised at the Physics [??] where they were doing demonstrations of physics. I said, “How is this related to magic?” And he immediately thought I was referring to conjuring tricks. It indicates the limit of these people that they couldn’t — what I was really after was how science is related to magic proper, you see. But anyway, so there was this extra dimension of magic, which to some extent, in some degree sort of tends to transcend science a bit.

**Bohm:**

Science should have been part of it, but it transcended this rather limited atmosphere of the city, which was sort of very ugly and restricted and so on. This rectangular grid.

**Wilkins:**

Yes and the flat.

**Bohm:**

The flat. The great view and also the wind blowing through the trees and the freedom, the sense of freedom.

**Wilkins:**

Yes, there was magic up there. And you mean magic implies some degree of freedom because it provides you with special opportunities, which are not available in ordinary life.

**Bohm:**

Well, you're not restricted the way you are in ordinary life.

**Wilkins:**

I mean I think if I remember rightly, magic is defined as doing things with the world with the aid of spirits, isn't it? The unnatural forces.

**Bohm:**

That's one way of looking at it, yes.

**Wilkins:**

I think that's the kind of —

**Bohm:**

Well, the other view of magic is sympathetic to say that things connected not by mechanical contact, but even distant things are connected by sympathy, similarity of form and structure.

**Wilkins:**

You don't postulate any spirits, but just a principle of connectedness.

**Bohm:**

Yes, of connectedness through some form other than mechanical.

**Wilkins:**

Ah, you mean the sciences confined to the mechanical.

**Bohm:**

Right, present anyway. I wouldn't have said so much in the beginning myself, but at least the way it's developed.

**Wilkins:**

Yes, because I think obviously people say there is magic in science.

**Bohm:**

Well, there is in a way. It tends to move in such a way as to people try to get rid of it.

**Wilkins:**

Right. It seems to me that this whole question of magic in science? Well, anyway, come back to it. I must give some attention to this because I feel there's something in relation to all these higher values of science. I mean, the question of magic is relevant. However, getting back to your story. Yes, you are getting an extra freedom of the spirits on the hills with the wind and the breeze.

**Bohm:**

And the view, the Bay and the Golden Gate Bridge and Mt. Tamalpais.

**Wilkins:**

The whole vista.

**Bohm:**

The cloud, the brilliant sunsets and the clouds.

**Wilkins:**

Now, would you also say that sort of view where you've got this great sort of vista, in a way has conveyed some feeling of unity?

**Bohm:**

Yes, it was all — I was clearly a vast unity.

**Wilkins:**

You have one sweep of your vision and you encompass this whole thing in an instant.

**Bohm:**

Yes, that was unity, but also beauty and freedom. It had really been the most beautiful place I'd ever seen to date.

**Wilkins:**

Yes, I think the — I was talking to the young physicists here to cheer them up so they'd be prepared to think about weapons research as well. It's perfectly true. This element in science, isn't it? When you have any sort of level of achievement you get a special exhilaration, don't you? Because you like getting to the top of the mountain peak. I don't know how many of them have felt it at that age, but I think they might imagine it. But I think it's the right way to talk. I think it goes rather beyond the ideas of beauty because I think when scientists talk about beauty they often have, in my impression, is they have a rather limited idea of aesthetic beauty, aesthetic pleasure. And I feel that this is rather more like food tasting nice.

**Bohm:**

Yes, they wouldn't say that looking at the bay gives you aesthetic pleasure. It was something more than that.

**Wilkins:**

Yes, so you are putting the term aesthetic pleasure on a rather lower level that this experience has a more profound meaning and satisfaction. You would say the satisfaction you get from aesthetic pleasure is a rather limited kind.

**Bohm:**

Yes, but this is a kind of total involvement.

**Wilkins:**

Yes, exactly. Total involvement, whereas aesthetic pleasure relates to rather some special or specialized sort of sophisticated pleasure sort of channels. I think this is very important because I think that most scientists, when they talk about beauty in science, I think they tend to look at it in a rather limited way. It's very difficult to get them to face this fact. They really do have, I think, most of them, I mean deeper down, stronger feelings than this, which they don't like to admit. Anyway, you got that.

**Bohm:**

A sense of being totally involved, of being free to move around.

**Wilkins:**

I think that's a good, necessarily total involvement implies —

**Bohm:**

Yes, and also no holding back, as it were. In a sense that?

**Wilkins:**

No holding. Yes, you risk all, which is to some extent what is always involved in created activity.

**Bohm:**

Well, I didn't even see it as a risk. Just a sense that saying I was totally involved and was not holding back my feelings toward that scene. So evidently a lot of people must have felt that way if this woman called it Storybook Road and magic.

**Wilkins:**

And I suppose that probably — I mean, what do you think yourself about your whole career in relation to risk? Have you ever felt any holding back when you



had unorthodox ideas, which you felt might be popular with other people?

**Bohm:**

Not really, no.

**Wilkins:**

You mean that's never really hold you back. But when you put it the other way that sometime, to some extent, you even have found it somewhat exciting and exhilarating that you had ideas that other people might really find rather might be a little bit resentful about?

**Bohm:**

Well, I don't know if that would have exhilarated me. I think that it was the sense of the scope of the view. Like seeing this tremendous view, this tremendous —

**Wilkins:**

Yes, it's the breadth and magnitude.

**Bohm:**

And the beauty of it and the freedom and so on.

**Wilkins:**

I was looking up the actual meaning in the dictionary the other day and one of the meanings it said was importance.

**Bohm:**

Yes, that's true.

**Wilkins:**

Sheer sort of importance that the — of course, one immediately says important in what sense?

**Bohm:**

Well, it doesn't matter what sense of the state you see, but?

**Wilkins:**

Any importance. So your whole spirit was sort of raised up.

**Bohm:**

Yes. Even when I got discouraged I could go up there and get out of it.

**Wilkins:**

Yes, you mean it was a little bit like the devil who took Christ and put him up on the mountain where he saw this thing. Of course, he made a specific offer there of power or something. But the symbolism of being raised up on top of the mountain is the same thing, isn't it?

**Bohm:**

Well, yes, the other point was that it was the view. As I sort of tied up with this old American dream of the West. Even the name Berkeley comes from Bishop Barkley who said westward the course of empire flows or something. This was as far west as you could get.

**Wilkins:**

Oh, you mean it was named because Berkeley had referred to the West?

**Bohm:**

He said, “Westward the course of empire flows.”

**Wilkins:**

I see. You think that this westward quote was the reason?

**Bohm:**

Yes, that was the cause of the name.

**Wilkins:**

Really? Oh, very interesting. Do you have anything that — but isn't he called Bark?

**Bohm:**

Barkley, but they just rechaged. Called it Berkeley.

**Wilkins:**

Really, gosh. And it was really like that at the time.

**Bohm:**

Yes. I suppose when they arrived there and looked down on it they said, well, that's it.

**Wilkins:**

Yes. So in some ways it was the sort of experience which people got in the '20s when they went to work on under Rutherford in the Cavendish that there was a sort of special sort of spirit there which raised people up so they could do work which was much better than what they'd do in other circumstances.

**Bohm:**

There was a spirit that gave you energy. Oppenheimer had a lot to do with it, but also the area at Berkeley itself in some way did it. Not necessarily — at that time it did. Maybe now it wouldn't. I don't know. It's all built up now and probably would be much less?

**Wilkins:**

Yes. You mean there are fewer trees.

**Bohm:**

Yes, well, they've got all the Cyclotron building and they've put up radar towers at the top of Grizzly

Peak. So I don't know. The whole thing has a different aspect.

**Wilkins:**

But it seems to me you've been a little bit hard on the flat part of Berkeley down below with this rectangular grid. I know there are very pretty gardens.

**Bohm:**

Oh, there are very nice parts to it. Yes, I agree.

**Wilkins:**

How did all these pretty flowers growing in the gardens —

**Bohm:**

Well, that's fine, yes. That's good, but it didn't affect me as much as —

**Wilkins:**

Well, this is really what I'm getting at. The nice flowers growing in the gardens didn't really impress

you. What impressed you was the freedom of vision on top of the mountain?

**Bohm:**

Yes.

**Wilkins:**

I think this is important.

**Bohm:**

The freedom of the things growing wild and so on.

**Wilkins:**

Yes, yes. Because I think the — I mean, some people, their minds operate in different ways. Some people can tune in to the sort of grandeur and beauty of nature by looking at little flowers or something in a garden. Other people tune in, rather on a different level, and they need to be on tops of mountains. Actually, you said the same thing around the Penn State. Because you said it was the trees and big plants, which impressed you.

**Bohm:**

The trees growing wild, yes.

**Wilkins:**

Yes, the small plants, I think, didn't make much impression on you.

**Bohm:**

Well, it was all right. I liked them, but they didn't make that deep an impression.

**Wilkins:**

It was the big things. It was the magnitude of the things, which had a lot the impression. Incidentally, about big trees, do you know the enormous London Plagues in Lichiten [?] Fields? But if you don't know those you ought to go and look at them because they're not — I'll show you where it is. Really, they're terrific. They're about the biggest trees in the whole bloody London. In fact, some of them are so big that the branches go out thirty degrees horizontal and some of them are supported by great steel wires because they're afraid that — how they can stay up at all, I don't know. Immensely impressive looking at these enormous trees. I think you would like it. It's really worth a look.



**Bohm:**

Where is it anyway?

**Wilkins:**

Lichten fields is just about five minutes from here. I could show you on the map or we could go up if I didn't have to get back this evening. We could go up there.

**Bohm:**

Well, maybe another time we'll look at them.

**Wilkins:**

It really is a terrific experience because you know what it's like when you're in the redwoods or something to look up and it goes up and up and up and up and up. There seems no end to it. It's like that. Very big. And it's interesting to find that in the middle of a city because normally you don't find it in a city. The whole thing is more sort of — it's got manmade limits to it. Yes, so the big idea, the big sweep?

**Bohm:**

Well, and also, Oppenheimer gave a sense of a big sweep, too, and he —

**Wilkins:**

All branches of culture, you mean?

**Bohm:**

Yes.

**Wilkins:**

All his parties he had, and presumably at the party you say they had classical music or something like that?

**Bohm:**

Yes, well, he ended it with Beethoven's Quartet #14 in C sharp minor. It was a tradition.

**Wilkins:**

Did he have Melase [?] as well?

**Bohm:**

I don't know. Probably in between. I only attended the very last one somewhat later when everything had — it was not really the same thing anymore. See, I arrived when most of that had finished. I was the last student of Oppenheimer. The last one he ever had.

**Wilkins:**

Oh, really?

**Bohm:**

Except — well, in so far as he may have had — I don't think he had any students as such in Princeton. So anyway, the whole was going very nicely and then I got very interested in — we had these friends with whom I discussed politics especially. There were a lot of discussions with physics with many people and probably a bit of philosophy. But we began to talk about politics. Around Oppenheimer and that group there were several people who were really quite far to the left and oriented toward Marxism.

**Wilkins:**

These were sort of academic Marxists?

**Bohm:**

Well, no, I think some of them were more — like Ross Lomanitz used to engage in, helping to organize some sort of union there and to do other things. I don't know what all he did.

**Wilkins:**

So there was political organization and action to some extent?

**Bohm:**

Yes.

**Wilkins:**

Yes, I think I remember people interested in anti-racist questions.

**Bohm:**

Well, they put out — they did various things. I think some of these people took part in student affairs. There was a very active group, very vocal group in the left wing then. By the time I arrived I was in a right mood for listening to them because this long,

long period through the Depression reading slowly about how America, the West in general was not living up to its ideals, but was backing dictatorships quite often. In Spain they didn't come forward to help the democracy.

**Wilkins:**

You felt that did you?

**Bohm:**

Yes.

**Wilkins:**

Interesting. I hadn't taken in this point in Europe that there was a feeling about the position. You mean that with a feeling amongst left wing Americans that it would be the natural thing for United States?

**Bohm:**

Well, not necessarily United States, but there should have been some way to help the democratic government in Spain not to let it go under. The feeling was that perhaps many people in the American government didn't mind that it went under

because they didn't trust democratic movements. Reading in the left-wing journals like the New Republic, one got the impression that they would back up dictatorships in South America. That they had more confidence —

**Wilkins:**

This was historical fact.

**Bohm:**

Yes, they had more confidence in dictatorships than in democracy. The very protestation of democracy there was not serious or was reserved for only some places.

**Wilkins:**

Yes, they were afraid of Communism.

**Bohm:**

Yes, they were afraid of Communism. They were afraid even of democracy, that some of the profits would be reduced or whatever. They were afraid of loss of order. I gradually got the impression that they

were not serious with regard to the American values. At Caltech I got that impression even more because I saw these very cynic students that I told you about. That they were parodying these values and pouring scoring on them. Maybe they were just doing it as sort of a rag of some sort, but the very fact they would do it was already a sign of something.

### **Wilkins:**

Yes. Do you think their attitude was a bit equivalent to that of a young Russian scientist I met who had been doing research for possibly six or eight years? Very well established as having a research group and so on and when I got to talking with him he more or less admitted I believe in nothing. When I said what? Can I bring you anything from London the next time I come to Moscow? And he said yes. Well, first of all, he said no. But I said, “Look, what about a book or anything?” And he said, “Well, could you bring me, possibly, the Guinness Book of Useless Knowledge?” You see, so I had to go and find this. And of course when I bought the book I felt so silly I had to explain to the book seller that I was buying it for a Russian and not for myself. I felt such an idiot.

**Bohm:**

Well, that's the kind of cynicism that —

**Wilkins:**

Do you think that this was —

**Bohm:**

Well, it wasn't that strong, but it was a certain element of that in there of saying that they didn't really believe in the American political system. They were making fun of it. In a way, they did believe in their technology and science, but anyway I felt that such people would not find any difficulty in accepting fascism if fascism came. The same with a lot of people who backed all these dictatorships and allowed the Spanish democracy to go under.

**Wilkins:**

So the Caltech people, you say, had rather narrow interests in science and technology?

**Bohm:**

Yes.



**Wilkins:**

Rather than putting the science and technology in a broader sort of political and moral perspective?

**Bohm:**

Yes, they were rather cynical about that broader view as to whether it makes any sense.

**Wilkins:**

Yes, but you think that the sort of jokes they made, you think possibly weren't quite as negative as they way these Russians were?

**Bohm:**

No, it wasn't that negative. There were again certain features of the system, but they weren't totally negative.

**Wilkins:**

I think, actually, the Russian may well have been half joking about this, but he didn't want to get trapped in political discussions or something because it's probably embarrassing. So he preferred to make a joke and leave it at that.

**Bohm:**

But anyway, then of course when France and the West, Holland and Belgium, they all caved in and Britain was holding on just barely, I felt that it was more of the same. That they had not been really whole hearted in their opposition to the Nazi's and many of the people there and that they wanted to turn the Nazi's against Russia. I mean, in the beginning when the Nazi's made this Nazi Soviet pact I regarded the Russians as really — I thought that was very destructive.

**Wilkins:**

Compromising with evil, you mean.

**Bohm:**

Well, it was a bad compromise with evil. I said well perhaps it was only natural a dictator like Stalin would do it. So I didn't have much hope from that. When the West caved in it seemed the only people who were resisting the Nazis at that moment were

the Russians. Therefore, there was a more favorable attitude all around toward the Russians.

**Wilkins:**

Yes, there was.

**Bohm:**

I had begun to get the impression that with all the corruption and all the half-heartedness in this western or American system that had no solution, not only to fascism, it had no solution to the Depression or to the economic problems and only a war would allow it to function in a full way.

**Wilkins:**

Oh, yes, you mean this was a piece of political economic theory that capitalism had to get — in order to get rid of it's contradictions through war?

**Bohm:**

Well, but it wasn't only a theory. It was clear that things were picking up because once the war started in Europe — [??] that they had put people, they had mistreated people and had some trials where —

**Wilkins:**

The show trial.

**Bohm:**

The show trials.

**Wilkins:**

Were very sort of peculiar, weren't they?

**Bohm:**

Yes, and also the Nazi Soviet pact and the invasion of Finland. All sorts of things disturbed me, but on the other hand I said if you've got the civilization, which is sort of caving in, it's much worse. That's the way it looked. As least as bad and maybe they had a new idea, which would meet the problems in spite of all these negative features. That was the sort of attitude. Then I began to listen to these theories of Marxism and dialectical materialism.

Philosophically, the ideas excited me and I was sort of ready to listen to new ideas anyway and it meant sort of getting out of a rut that I had been in before in some way.

**Wilkins:**

But they're a very holistic aspect really.

**Bohm:**

Yes, that's right. Again, that vast vista of the whole was sort of again?

**Wilkins:**

All joining together all aspects of culture with politics, economics —

**Bohm:**

And everything.

**Wilkins:**

And religion and everything being comprehended somehow in one brain.

**Bohm:**

And also, the dynamic moving nature of it in dialectics and to say that it wasn't fixed. The a unity of opposites excited me in saying that all these opposites, things which seemed opposite were

actually underlying unity and that out of them would emerge creatively new synthesis.

**Wilkins:**

It was alive.

**Bohm:**

Alive. It seemed that the other ideas, other philosophy was very limited in static. I remember having a talk with one of the physicists there, Stanley Franco; we were trying to discuss dialectic. He said, “I can understand the need for flexibility, but I don’t see what you mean by dialectic.” I felt that was a sign of the difficulty. Flexibility meant only some adaptation within the existing framework, whereas there was something really dynamic and creative and revolutionary involved.

**Wilkins:**

Yes, of stepping out of creating new framework.

**Bohm:**

I felt that was what western society needed to do anyway. That framework somehow was becoming exhausted.

**Wilkins:**

Yes, you mean the idea of political revolution by force was to some extent dependent on the philosophical idea of revolution in thinking, revolution of new idea.

**Bohm:**

Yes. Well, you can have a physical revolution without that, but then it's scope is very limited. The major point was to say that there would be a creative liberation of human life and ideas and thought and everything rather than a mere political change. So this dialectic, yes, I thought a lot about the unity of opposites and to some extent it inspired some of my work in plasmas, as we'll come to that later. I don't think at the time I understood it all that well. I mean, we discussed it as well as we could and read some things, but it was more getting excited about it than actually understanding it.

**Wilkins:**

Yes, mind you, if you got excited about it you must have been getting something real out of it then. I must say that when I was in Cambridge as a student,

when I had a certain amount of discussion with Marxists who were scientists and other students, there were certain aspects I found. Unity of opposites thing, I must say, I could have really got stuck on. No one succeeded in making it sound at all interesting. Quantity into quality.

**Bohm:**

Yes, that was another thing — quantity versus quality.

**Wilkins:**

That was a real simple concept. But that seems to me to some extent rather a banal one. I mean, that doesn't seem to me the same profundity of interest.

**Bohm:**

There was quantity and quality and there was — I don't think that Marxist generally had a very profound notion of the whole dialectic process. Or even of what Marx had done, or Engels or Lenin. I think we were discussing on a rather superficial



level, but even that level was enough to give overtones that were enough to arouse my energy.

**Wilkins:**

Yes. What was this about unity of opposites in your plasma work?

**Bohm:**

Well, I'll get to that later. I wanted to try to keep some time sequence. But I felt that this unity of opposites was a very important idea. Quantity into quality was obviously there. I can't remember all the details exactly how we thought of it. And the socialism. I began to feel — it was a changeover from my earlier individualism and democracy. In socialism we would have another new idea of people working together. One began to feel that leaving it to the individual initiative was too chaotic. I mean, people had their own particular interests. There was no reason why satisfying their interests would work to the general good, or even to any rational end.

**Wilkins:**

Did you feel that science in any way was a cooperative, common activity, which in a way could be a model for society?

**Bohm:**

Well, I don't know if I felt it that strongly at the time. It was clear that it wasn't principle communal activity in a sense, but it was contributing to something greater than himself. At the same time, everybody wanted to make his own individual contribution and put a lot of emphasis on that. I think it was more the idea that you couldn't trust a whole bunch of individuals, each one doing his own thing, to come out with anything coherent and sensible over in the whole. That people had to get together and look at the whole and make some plan together and work it out. The purpose of the whole thing was to allow each individual to fulfill himself, but you had to get together. People had to get together and form some whole plan to be able to do it. Even with Roosevelt a touch of that was there. So you have to carry it very much further and more systematically and deeper. That was the feeling I had. The socialism, therefore, began to make sense to me in a way that it hadn't before.

**Wilkins:**

Yes. You mean needed state intervention to try to coordinate the —

**Bohm:**

Yes. So I didn't even think of it as state intervention, but you needed to have an organizing body of some kind to bring it all together.

**Wilkins:**

But when Roosevelt used state intervention —

**Bohm:**

Yes, I wasn't against it at all. You needed some state intervention to keep at least — but he said you at least needed to keep things fair. That people who have accumulated money have such an advantage that only the state can help those who don't. That was the sort of philosophy. So the state intervention was needed to sort of maintain certain fairness. This was much further to say this — the collective action, not maybe intervention, but the collective action was necessary to organize the whole thing to make it so that it would all work and be creative.

**Wilkins:**

Yes. You mean that the action comes from inside rather than from outside, being imposed by the state.

**Bohm:**

Yes, it was really the will of the people that they would work together while leaving as much freedom as possible to the individual. But see, the idea was individual clearly couldn't manage in front of all these big corporations or in front of big government organizations. So you had somehow for people to get together in a different way so that they would all really work together and be able to organize properly. But the whole thing had to be organized rather than just having it have to piece meal and so on.

**Wilkins:**

Well, I mean this is a very important problem. Say, in respect to the Labor Party and its policies right now here in Britain. So this is precisely where

socialists haven't been able to do any really adequate thinking, isn't it? I mean how do you, in a very large nation, get people working together so all their energies can contribute to joint enterprise? Did you have any ideas at that time?

**Bohm:**

I thought about it a lot, but I don't know if I? the idea, which was current at the time, was first you establish socialism, but in the capitalist framework it was not possible. That was the idea.

**Wilkins:**

What was the main characteristic of socialism? Was it state ownership or what?

**Bohm:**

Not exactly state ownership. The main characteristic of socialism would have been to have a society in which everything was done basically with the welfare of the whole as the primary?

**Wilkins:**

Yes, but I mean this is a general philosophical principle rather than a formula for political structure or action.

**Bohm:**

I don't know if we thought it out very well. The Marxist view was you had to have dictatorship of the proletariat as an intermediate phase, which would wither away eventually. The idea was eventually socialism made no sense if you had this big state bureaucracy. Most of it would have to be a temporary affair.

**Wilkins:**

It never worked out in the ideas about how it would wither away.

**Bohm:**

No. Well, they made excuses. If you asked them why it hasn't withered away in Russia, they say, well, Russia has been under attack all the time and how could you expect it to wither away.

**Wilkins:**

Well, there's obviously a good sense in that, but I don't think it's a sufficient answer because I think this is the big sort of gap in socialist political thinking, isn't it? That the actual forms, which socialist society will take, haven't been adequately formulated, have they?

**Bohm:**

No, and there may be much — by now of course, and much later hindsight, I see there are much deeper problems than anybody was considering at the time. But I think that my attitude now is to try to put it the way I saw it then. I don't think that I was raising such deep questions then. I had them in the back of my mind. As you'll see I think that my tendency was to put such questions into sort of a scientific form, which sort of was a scientific representation of the social problem. I saw the plasma as that.

**Wilkins:**

But in a way, I think you're not being fair to yourself when you say you didn't put them in deep

questions. Because in a way the general principles, which you enunciated, devalue everything we've done in the interest of the whole community. I mean, these are deep principles, aren't they? But they're general principles, whereas presumably what you and the others lacked at that time were clear practical ideas about how these principles might be put into action. That was what was —

**Bohm:**

Yes.

**Wilkins:**

Particular lack of profundity.

**Bohm:**

Yes, but I think that actually there's no way to be put into action without going into the nature of human consciousness. Even Marx recognized that, but he looked at it in another way.

**Wilkins:**

And now you're talking from your present position?



**Bohm:**

From the present position. I think at that time I was not able to see it, but I had a vague glimpse of it. Or even Marx would say that consciousness will be transformed when — See, the basic attitude of Marx, as I took it, was that people would change when society was organized differently. I had talked with my friend Mr. Weiss, the father of my friend. Endlessly when I was in Wilkes-Barre. And he would say, “People will only do things if you frighten them. They won’t work, they won’t do anything unless they’re frightened either by lack of money or by being put in jail or by being tortured or something.”

**Wilkins:**

Fear.

**Bohm:**

Fear is the only motive that you can count on. I said, “No. That may be the case at present, but if society changed that would be all different.” So that was my feeling at the time. Now, that was more or less what Marx was saying. He was saying that as long as

exploitation of classes is the basic structure, human consciousness cannot be anything but at a very low level. When society changes it will be all different and work won't be a burden, but it will be a creative joy thing. I sort of more or less accepted that. Now, I don't think that the picture is entirely right now, but we'll come into — that we should discuss later.

**Wilkins:**

There's more to it.

**Bohm:**

There's more to it than that.

**Wilkins:**

But presumably you weren't, at that stage, particularly worried about the lack of concrete political policies, which if put into action, would be sort of working according to these basic principles?

**Bohm:**

Well, I think the idea was that if you ask why it's not been possible to do this in Russia, they said first of all it was in the primitive condition. Secondly, it was being attacked all the time. The assumption was that once you raised the technical level and once you got rid of this danger of war people would naturally start to do all this.

**Wilkins:**

Yes, but you mean you were to some extent satisfied with this current apology for the lack of greater success in Russia?

**Bohm:**

That's right. They quoted something like this. Lenin said that, "Communism equals Soviet power plus electrification."

**Wilkins:**

Yes, I remember that.

**Bohm:**

The minute I said, “Okay, that seems plausible.”  
Because it tied up with my earlier view that poverty  
was the main cause of human suffering and that if  
you got rid of poverty then things would change.

**Wilkins:**

Didn’t he say something about American efficiency  
at some point?

**Bohm:**

Yes, he may have said something like that, yes.

**Wilkins:**

Well, certainly I remember this electrification. As a  
physicist this was very impressive.

**Bohm:**

It was impressive applying science in everything and  
then we would come to a state where human  
consciousness would change.

**Wilkins:**

Yes, very seductive thing. But you were not unduly concerned with the fact that the left Marxist thinkers were not putting forward concrete plans for how things might —

**Bohm:**

Well, I thought that it was not the time. We were in the middle of the war. The first thing was to get through that.

**Wilkins:**

Well, I think that was of course perfectly reasonable. Yes. So that one of the things that was another factor, what interested you in Marxism, was that Lenin would refer to the role of science in helping to enlarge you in consciousness.

**Bohm:**

Yes, and Marx, in a way, less so, but it —

**Wilkins:**

Yes, he thought his whole approach was a scientific one, didn't he?

**Bohm:**

Yes. The idea was that through rationality science, more generally through a rational approach one could solve these problems. Whereas it seemed that the West had given up that idea. They were sort of tacitly saying these things will stay with us forever and there's no solution. Somebody like Mr. Weiss had more or less said so openly saying that only fear can drive people and from now on, forever. Therefore, everything was going to be irrational from now on and you can't do anything about it.

**Wilkins:**

Yes, you mean that in Europe as a whole the idealism of the French enlightenment, a lot of it had got very thin.

**Bohm:**

Yes, with the collapse of the resistance to Hitler. The fact that Europe had, to some extent, encouraged it or in the hope that he would attack Russia. And then they had collapsed in front of him.

**Wilkins:**

But even before it wasn't all that strong.

**Bohm:**

Well, it was never all that strong, but I hadn't realized it until later, of course.

**Wilkins:**

Well, I mean it was strong in certain circles in the eighteenth century in France, wasn't it?

**Bohm:**

Yes, but still they couldn't stop the excesses of the French Revolution.

**Wilkins:**

That sort of caused them extra [???]. When you added Wordsworth and all sorts of people going over to Paris during the Revolution because they thought this was such a wonderful guide to the whole of humanity. That's so, isn't it?

**Bohm:**

Yes.

**Wilkins:**

But they didn't really want that all keyed on results.

**Bohm:**

Anyway, in a way it sustained my hope that something could be done. All this discussion. That perhaps humanity was not doomed to irrationality and a fear and hate and just going on and on with this mess forever. But rather there might be a way out. It seemed that people like — if I say people like these Caltech students had shown just plain cynicism about the ideals of the West and evidently didn't believe in it and some people did. But it was clear that it was getting thinner and thinner, as you say. So I think that was a very important — that phase gradually took hold of me.

**Wilkins:**

This was also an idea about the whole, wasn't it?

**Bohm:**

Yes.

**Wilkins:**



The basic principle, as you say, of this type of socialist thinking or communist thinking was that every individual's actions should be contributing to the interest of the whole.

**Bohm:**

Yes, and the whole should be supporting every individual in his creativity.

**Wilkins:**

So this is essentially a holistic, organic philosophy of unity and creative change.

**Bohm:**

Well, unity within diversity and so on, you see.

**Wilkins:**

But you're back to this whole question of the relation of the individual to the whole. The one which you've been with all your life, so to speak.

**Bohm:**

Yes. So, anyway, that was the political content. But meanwhile, of course, the war was extending and Oppenheimer was getting less and less involved in physics there. He eventually went off to Los Alamos and he asked that I come along, but as I said, they gave an excuse and I wasn't allowed to go.

**Wilkins:**

Who? What was that?

**Bohm:**

That was my parents. I had relatives in Europe and Czechoslovakia. It was obviously an excuse. I knew it was. Because by then I had become fairly close to these left wing people and I knew that the reason was that they did not like my left wing views.

**Wilkins:**

Oh, I see. So when Los Alamos was set up and you were already known to have left wing views —

**Bohm:**

Well, I'm sure that they were watching, you see.

**Wilkins:**

So they didn't want — they felt you were a doubtful security risk at Los Alamos.

**Bohm:**

Yes, but they didn't seem to mind my staying there at Berkeley.

**Wilkins:**

Yes, because Berkeley was a lower priority from a military standpoint.

**Bohm:**

The result, though, but since not only Oppenheimer, but practically the whole department, all the people went, except for two or three. This was a sort of a blow to me because most of the activity so much had been so involved in it was gone. So I kept on with these two or three who were also left wing people. Probably didn't get there for the same reason. We talked about different things. Even these, you see, this began to fold up. This fellow, Lominitz, was drafted. I was rooming with him in an apartment and he was drafted suddenly and he went to the draft board for an explanation. They couldn't give him one. Although, he was in priority work.

**Wilkins:**

He was just put in the Army?

**Bohm:**

Yes. After he got into the Army he was given basic training seven or eight times. They didn't want to send him to Europe. They didn't trust him. They sent him finally to Japan toward the war in the Pacific where they felt he could be trusted.

**Wilkins:**

His scientific training was sort of thrown away?

**Bohm:**

Was ignored, yes. The other fellow I used to know, Freidman [?] (I forget his first name), he was told by somebody that he'd better leave Berkeley quickly and get a job somewhere inland or further away or else the same thing would happen to him.

**Wilkins:**

You mean Berkeley was close to the coast?

**Bohm:**

Well, no, because if he was in World War — he was told to take a job somewhere else and get out quickly because somebody had his interests at heart said, “You’d better go away quickly or the same thing is going to happen to you.”

**Wilkins:**

You mean Berkeley was too much a focus of war work?

**Bohm:**

Well, yes. Also, they didn’t want him around. So he left.

**Wilkins:**

So they knew him?

**Bohm:**

Yes. I was left with Joe Weinberg. He was a fellow who had very definite views. It was very exciting at times, but I found him difficult at times because his views were so sharp and hard. Both in science and in politics.

**Wilkins:**

Is that the well-known Weinberg?

**Bohm:**

No, no, that's Steven Weinberg. So anyway, I used to visit his house and we'd listen — see, one thing he did for me was he brought me in contact with classical music. He had a big record player. Gradually, I began to find him difficult and he was about the only one left.

**Wilkins:**

What sort of difficulties?

**Bohm:**

Well, I couldn't really — when we argued — we had such different temperaments. Our basic argument was along these lines that he tended to get a very definite mathematical view. A very sharp and very hard and clear. I wanted to have a more intuitive view. That really was it. Where I would feel that I had the thing inside of me. So he said that was mysticism. But I said his mathematics was mysticism, it's just Pythagorean mysticism. He had to agree with that.

**Wilkins:**

You didn't really convince him; he had to agree with you.

**Bohm:**

Yes. Marxists tended to use the word mysticism as an epithet. So everybody had to defend himself against accusations of mysticism.

**Wilkins:**

[Inaudible] use it as a?

**Bohm:**

Yes. So had I understood better I would have said, "Well, what of it?" I wouldn't have attempted to defend myself. So anyway we didn't really get on. Sometimes we would get into quarrels. So it wasn't a relationship that was terribly helpful. I was getting very isolated. The other point was something I think I mentioned last time, but before everybody had left I gave this talk in my work to the whole department, which went very well. This talk sort of depressed me. I'm trying to explain why. I felt during the talk a feeling of tremendous energy of being in contact

with everybody and then afterwards a sort of a letdown, which lasted for about a year and I often found it very hard to work. People came up for days afterwards telling me how they like the talk, but this didn't help. It may have even depressed me some more.

**Wilkins:**

They'd come and say they enjoyed your talk, but they didn't say anything interesting.

**Bohm:**

No, it wasn't that. They said it was a wonderful talk and so on and so on, but somehow I tried to get hold of — At that time I was unable to say why it depressed me. In fact, I first explained by I went over it later and I said there were also some weak points in what I had said. I told Oppenheimer about it, and as I said before, he apologized for posing this problem, which had all these difficulties and insoluble features. But I think that wasn't the real problem. I was unable to really verbalize it. I think I began to see it later as a sense of meaning. This goes back to what I said before about earlier childhood of seeing light as reaching out and all the lights



reaching out into the darkness and contacting everything. I felt at that moment — I remember seeing a program on BBC, which was “The World of Shadows” about C.S. Lewis. It referred to Plato’s allegory of the cave, really, where the world of shadow was the people watching the shadows inside and they go out into the world of light and are blinded. This seemed to be the meaning of it that I felt at that moment in giving that talk with that state of high energy; I sort of entered the world of light. Then I sort of was sinking back into this world of shadows and people praising me for the talk was like saying, well, I could now become a pillar of the physics establishment and cast a bigger shadow than some of the others. But it seemed insipid. So the whole thing began to depress me and it took about a year to get over that or maybe more. But that tendency toward being let down combined with the fact Oppenheimer was withdrawing from the physics and eventually moved away, other people were moving away, and I was being left isolated. And then finally when they drafted Lomanitz and Freidman went away? Morris Freidman, I think. I can’t remember his first name. So I was almost —

and Weinberg I couldn't really get along with. This led to a rather difficult phase.

**Wilkins:**

But if I could just return to this. I'm not very clear. I mean, if while you were giving your talk you got this vision of these lights giving —

**Bohm:**

Well, I didn't see it as — I see it now as a vision of light. It was a kind of sense of light. Remember also that I did this very intense light that I always imagined, which would get so intense it would become invisible, like ultraviolet and so on.

**Wilkins:**

You had some remarkable feeling of uplift and illumination, you might say, during the talk.

**Bohm:**

Yes.

**Wilkins:**

Or rather unclear nature. Well, you felt uplifted.

**Bohm:**

Well, not only that, but in contact with everybody with tremendous energy and clarity. As a child I'd also had the notion that I wanted a super intense awareness. That I felt the ordinary awareness was a bit sort of dull and dead. When I read about adrenaline I thought maybe that would give it to you.

**Wilkins:**

What age were you then?

**Bohm:**

Fourteen, fifteen maybe.

**Wilkins:**

I see. So right from an early age you'd been especially interested in matters of especially strong on special types of awareness.

**Bohm:**

Yes, I felt the ordinary mode of awareness was rather foggy or weak. Somehow it wasn't really what would be really the one we were suitable to.

**Wilkins:**

What kind of thing was it that made you think about this limits to awareness you wanted to do better?

**Bohm:**

I can't remember. Possibly, the general feeling was — see, if you take the general feeling — it's best expressed by this term, the world of shadows. That the world of society was a world of shadows.

**Wilkins:**

You felt you were living in a world of shadows?

**Bohm:**

Well, I couldn't put it in those terms. It's only now that I see that expresses the feeling.

**Wilkins:**

So living in a world of shadows stimulated you to think about or conceive of a world of light?

**Bohm:**

Light, yes. Light and life.

**Wilkins:**

It seems again an example of how your adversity, in a way, stimulated you into creative activity. And one might (I'm sorry to harp on this) say that the adversities of your parental relationships may again have stimulated you to investigate possibilities of enhanced awareness. Did you sort of feel, incidentally (I don't want to go on about this much), but that in your family life there was a sort of lack of awareness?

**Bohm:**

Yes, yes, it seemed dull. The whole thing. My father and mother were so involved in their hatred for each other they couldn't have been very aware. I often felt that I had to even seek dullness in order to avoid becoming disturbed.

**Wilkins:**

Positively negative, you mean. A strongly negative sort of thing.

**Bohm:**

Right. Sometimes I wanted to become dull in order not to get involved in all that. And also, not only there, but in the whole society around it also.

**Wilkins:**

You mean you saw considerably strong negative forces, and one way to prevent/avoid these sort of hurting you was just to become dull.

**Bohm:**

Yes, apathetic in certain ways.

**Wilkins:**

Perfectly natural reaction. And yet at the same time it was also stimulating. You to try to find some other form of —

**Bohm:**

I had this vision of super intense light awareness of something more real.

**Wilkins:**

Yes. Don't you agree it's rather sort of interesting about the — I mean, you seem to be more or less agreeing with my suggestion that the real adversity of your family life may have stimulated you to this kind of searching.

**Bohm:**

It doesn't mean it couldn't have happened in another way.

**Wilkins:**

Yes, quite. I mean, there's no proof whatsoever, but at least it is consistent. It's a hypothesis, which at least is consistent with the facts.

**Bohm:**

I remember, even when I was fourteen or fifteen, this notion of a super intense light could excite me tremendously — would really raise my blood pressure.

**Wilkins:**

In the Middle Ages, I was told by a well-known southern medievalist, who was a very good man that I visited once very briefly at Oxford, when I showed him the picture of the Virgin Mary squirting the milk from her breast into the eye of the kneeling monk or something, he said he'd never seen this before and it was rather interesting. He said, "Well, this wasn't divine illumination that was going into his eye." It was spiritual — normally these rays, which you've got in a lot of these medieval prints, rays of light or rays of milk, in this case, was symbolic of spiritual salvation. So it might be that your rays of light spreading out were symbolizing spiritual salvation.

**Bohm:**

Well, something. I don't know exactly — spiritual life, you see.

**Wilkins:**

Yes, well, in a way it's the same thing, isn't it? Because you couldn't have salvation without life and so you don't have much of a life without salvation.



**Bohm:**

But also, the rays spreading out from the setting sun had another sort of a feeling of promise of something.

**Wilkins:**

Okay, well, promise is like [???]. See, I think the thing is we normally tend to think today about rays of light as giving intellectual illumination, don't we?

**Bohm:**

Yes.

**Wilkins:**

It casts light on something and it will enable us to figure it out. So it's an intellectual thing. Whereas I'm not sure about all this and I may have gotten it a bit muddled, but certainly some of the rays then in the Middle Ages symbolized spiritual salvation. And I think maybe there wasn't much spiritual salvation in your parent's relationship, was there?

**Bohm:**

Nor anywhere around me.

**Wilkins:**

Yes, outside. You mean that your parents were grinding each other down and that you felt society as a whole was tending to grind everybody down.

**Bohm:**

Yes.

**Wilkins:**

And not raise them up spiritually. This thing you're standing on top of the mountain and looking out over the bay, as I said, this is what Jesus did in the New Testament. That was mainly a spiritual matter, wasn't it? It wasn't an intellectual matter.

**Bohm:**

Oh, no, if you want to say it's a spiritual — the meaning of the whole scene in Berkeley was spiritual, yes.

**Wilkins:**

Well, I think this is — so really you can say that these physical systems of being on top of a mountain, of seeing light, of rays of light reaching

out into darkness, all these you might say, symbolize spiritual.

**Bohm:**

But also, the notion of the super intense awareness would have been of a pervasive light in which everything could be seen as it is.

**Wilkins:**

Presumably, that was what you might call a kind of spiritual illumination.

**Bohm:**

Yes, but also, being seen as it is, everything was in contact. Somehow it sort of tied up with this early picture of the universe as a sphere. A four dimensional sphere with tubes, everything being tubes that met at the center.

**Wilkins:**

I do feel that since a lot of your imagery is visual in these matters, that some kind of, even if you only did diagrams yourself — the roughest diagrams, I think, would tend to reinforce the meaning.

**Bohm:**

To some extent, it seemed to tie together when I heard this music of Beethoven and Mozart. It had some sort of related meaning.

**Wilkins:**

You mean you had a spiritual uplift?

**Bohm:**

Yes. But when I first heard Beethoven's Concerto #5, I felt that it was a sense of rising up to the absolute top. And I had the thought that this was what was wrong with Oppenheimer. He wouldn't do it

**Wilkins:**

I see, at that time.

**Bohm:**

But see, the other thought I had was in this slow move in, this is of religious intensity, which rather surprised me because I was anti-religious.

**Wilkins:**

Well, you were anti-religion.

**Bohm:**

I was very surprised to use religious as a word of praise. I found this confusing.

**Wilkins:**

Yes, I see. But evidently the spiritual sense was very much alive in you at that time and was brought out by the music and the experience of standing on the hill.

**Bohm:**

Yes.

**Wilkins:**

Presumably, this chap Weinberg, was lacking in spiritual sense and liked to believe in the absolute truth of mathematics.

**Bohm:**

Yes, that's right. He also had the notion; he tended to focus on particulars. He had the idea that every

problem had a specific weakness. So he would find the specific weakness of each problem. I think he was very good at it. In fact, he went into industry when he couldn't get a job.

**Wilkins:**

He was a very good technician.

**Bohm:**

More than a technician. He was really able to use mathematical analysis in a powerful way. He found the specific weakness of each problem so that he could express in analytic form, a very difficult problem. Which I could see was very good because once you have an analytic form you can understand a great deal more about it. But that was not something I was apparently able to do very well.

**Wilkins:**

He was sort of a technical master, technical mastery of mathematics.

**Bohm:**

Yes. He had some originality in the ability to solve these things. It wasn't purely technical, but he had a

certain approach to it, which was against this sort of intuitive spiritual involvement.

**Wilkins:**

Now you're coupling intuitive with spiritual.

**Bohm:**

Yes, I think they have to be coupled.

**Wilkins:**

Yes, you mean both concerned with overall feeling for something. You mean they came to be not very clearly defined, is that right?

**Bohm:**

That whole involved something pervades and suffuses the whole, rather than something you can focus on.

**Wilkins:**

And they also are concerned with meaning and value.

**Bohm:**

Yes.

**Wilkins:**

Which again is a sort of very holistic sort of concept. Yes, what the hell intuition is. Because the psychologist apparently sort of hate it because it's a thing they can't measure or study.

**Bohm:**

Well, another word for it to be insight. A feeling, not really insight in a sense of visual imagery, but a feeling.

**Wilkins:**

You mean feeling into things.

**Bohm:**

Feeling into things along with seeing into them.

**Wilkins:**

Rather than reasoning into things by succession of steps.



**Bohm:**

Yes.

**Wilkins:**

I think people tend to suggest that intuition tends to be fairly instantaneous and not as a result of a series of mental processes.?

**Bohm:**

Yes, I think that's so. It's a kind of direct apprehension at a level which is beyond the ordinary logical level.

**Wilkins:**

And of course then some people say it might be a little bit like our instinct in being of a rather known intellectual quality, but it might still..

**Bohm:**

Well, I don't know if it's anything like — I mean, I don't think that comparison is appropriate. I think that goes beyond the intellectual.

**Wilkins:**

Oh, yes, sure, but there's no reason why. I think it's Bergson — I don't understand what he talked about. He definitely talks about instinct in this relation.

**Bohm:**

I don't think instinct is what's already standing within. It's something — this was a perception of what has never been seen.

**Wilkins:**

Yes. Well, I don't understand what he means, but I think maybe what he means is that it's using parts of the brain, so to speak, which are not concerned with the intellectual —

**Bohm:**

Yes, I don't see why we should call it instinct.

**Wilkins:**

No, I agree. I'm a bit puzzled by that. Actually, I think I did have a thought about it somewhere, which did help. I forget it now, but insight —

**Bohm:**

Well, insight is good, but it leaves out that feeling element. It's implicit there, but it doesn't explicitly bring in the feeling element. Einstein said his perceptions began with feelings.

**Wilkins:**

I think that one of the things about feelings is they often tend to be — I don't think vague is the right word, but they came to be rather undefined.

**Bohm:**

Ambiguous, yes.

**Wilkins:**

What?

**Bohm:**

Ambiguous, not clearly defined, as you say. They're dynamic — they're moving.

**Wilkins:**

That's a point. You think they're moving.

**Bohm:**

They're like feeling out fingers. I once had a dream where I had the notion of millions of little rays of light, which functioned like fingers that were feeling out. It combined the visual and feeling that the fingers were feeling out something inside of me. Millions of fingers working out, finding out what, probing?

**Wilkins:**

So you're really connecting intuition with the notion of play then?

**Bohm:**

Yes.

**Wilkins:**

Play takes time.

**Bohm:**

Well, the perception — there is a stage, which takes time.

**Wilkins:**

I wouldn't have thought it reasonable to suggest that intuition is immediate.

**Bohm:**

Well, there's a time process and then there's an insight, which is immediate.

**Wilkins:**

Yes. You mean that the — it's an interesting point if you think it is to do with play. You said you had this image of the fingers probing?

**Bohm:**

Yes, millions of them. They weren't exactly fingers. They were rays, but they were functioning like fingers, probing. But they were also rays of light at the same time.

**Wilkins:**

Yes. That's working all right. So now we're starting. Go ahead.

**Bohm:**

Well, there are a few points that we discussed last time I think should be added to them. We were talking about at the end, I think, about this dream I had with these fingers of light sort of probing the brain.

**Wilkins:**

Yes. What about the light?

**Bohm:**

There were a lot of fingers of light. A very large number of very fine rays of light sort of probing. I had the sense they were probing the brain or something.

**Wilkins:**

Probing into your brain?

**Bohm:**

Yes. Maybe that was a kind of model of attention, you see, that's what I thought, that sort of scanning the brain.

**Wilkins:**

You mean things are coming from outside into your brain?

**Bohm:**

Well, from the general space into the brain.

**Wilkins:**

Not your brain probing out into what was around?

**Bohm:**

No. It's the other way around. That the fingers of light were probing the brain. If you take an object that you can't see and handle it, you'll gradually form an image of it as you move it around, touch it, and handle it. And simultaneously, this movement brings you information and simultaneously changes the object, moves the object. That was the kind of impression I had in the dream.

**Wilkins:**

How did it move the object? Do you mean it gives you a different view of the object?

**Bohm:**

Well, no, but if you're handling an object.

**Wilkins:**

Oh, handling the object. Turning it 'round.

**Bohm:**

Yes.

**Wilkins:**

I see. Looking at it from different angles.

**Bohm:**

Yes, but the fingers are touching the object in different ways, you see.

**Wilkins:**

Yes. Your fingers are touching.

**Bohm:**

Well, these light fingers were touching.



**Wilkins:**

It's almost like a blind person feeling an object they have in their hands.

**Bohm:**

That's right. The idea was light is like the blind man, actually.

**Wilkins:**

I see. So your brain is probing into the?

**Bohm:**

Or something is probing into the brain, you see, into whatever information the brain has.

**Wilkins:**

You mean there is another level of self, which is operating on the brain.

**Bohm:**

Yes. This instrument is sort of a space; it's in a space that includes the brain.

**Wilkins:**

This is a model of consciousness. You are conscious of the thoughts going on in your brain, so you were conscious of the probing into your brain.

**Bohm:**

Yes. The probing was necessary for consciousness, you see. It's attention, a kind of attention. For example, it's been shown that to see something the eye has to scan the object in a pattern. One might suppose that some sort of scanning is going on of the brain as a whole in what is called attention. Now the model was suggested that what is attending is beyond the brain, you see.

**Wilkins:**

As Niels Bohr says, "What is looking at that." There is something beyond that.

**Bohm:**

We won't say that. There is a mind. That was one of the points. Now, one of the notions that light is simultaneously — It goes back to this childhood feeling that light was sort of rays reaching out and

touching everything. These rays would not only act on things but carry information back. It was simultaneously, just like the blind man, probing. Simultaneously doing something and getting information.

**Wilkins:**

Yes. That's fine.

**Bohm:**

It's going well.

**Wilkins:**

All right.

**Bohm:**

I think also we were discussing the other time this experience I had at this seminar, that went well, and I had a feeling of letdown afterward. Or this notion of feeling, that thought was expressed by this phrase of a world of light and world of shadows, which would represent Plato's allegory of the cave. Now one of the points was that I felt that this was not only a world of light for me but actually it was everybody was in it. That this was the essential point there

would be light that would be shared by everybody, bring everybody together. In other words, at the highest state of being would be one in which everybody would enter this world of light so they would all be related, would form one.

**Wilkins:**

Coming out of the shadows.

**Bohm:**

That's right. And in coming out of the shadows, they would all be united by this light, you see. Which is sort of these rays reaching, touching everything, connecting everything. So, I think that theme began to reoccur later as you'll see, so I thought I'd go over it a little bit now. Now, there's one other point. In discussing how I came to Berkeley, and had all these new things happening with Oppenheimer, and all the students discussing physics and politics and so on. We discussed some of the new political ideas like Marxism. But I neglected to say that with Weinberg I had intense discussions of Bohr on complementarity, you see, which Weinberg regarded as a form of dialectic.

**Wilkins:**

Was Weinberg a Marxist?

**Bohm:**

Yes. At least he was very interested in Marxism anyway. We discussed the whole notion of complementarity and the fact that the conditions of the experiment would bring out the one form or the other, momentum or position or wave or particle. And they were in opposition that the conditions which would bring out one were incompatible with those that would bring out the other. Therefore I think we were regarding it as a kind of unity of opposites; that they were to some extent in conflict but yet united. They were at least in opposition but yet united. That had a strong effect on me. At that time, I was convinced that Bohr's approach was the right approach and for many years I continued with Bohr's approach until, you'll see later, I began to question about 1950. All this discussion was taking place around 1941 or 1942. So I think that began to get me interested in philosophy. You see, my first real introduction to philosophy was in this discussion of Bohr and then Marxism, it's relation to

Marxism and so on. The primary example of unity of opposites, which we had in mind then, was complementarity, though of course, things like quantity into quality were in our minds. But in my mind, the major question was the individual in the society, you see. In fact, even that experience at the seminar was an example of it, the sense of an individual somehow being related to the whole group in the seminar.

**Wilkins:**

When you were giving the seminar, you mean, you felt something very valuable was happening while you were talking in this special relationship to the whole group.

**Bohm:**

Yes, something unusual was happening anyway. And in fact, it seemed to show up because people talked about it for several days.

**Wilkins:**

You got an impression of something new happening, a new type of experience which you hadn't had

before, which occurred when you were speaking to the audience.

**Bohm:**

Yes, with that great intensity and with that extremely thorough preparation.

**Wilkins:**

You felt that you had put yourself into this talk and when you gave the talk to the audience, it had some special effect on them.

**Bohm:**

On both of us — on me and on the audience.

**Wilkins:**

Yes. So there was a totality of interaction which was something new for you.

**Bohm:**

Yes. A oneness, you see, a wholeness. Then to go back to the ordinary state was a very great let down. I tried to explain it to myself by criticizing what I had said. I was let down because I felt that it really wasn't as good as I had said. But that wasn't the real

explanation because if that had been all there was to it, I would have gone on to something else, which didn't have these defects, to do some more research. I would have looked for something else. But I think that actually the letdown was that I felt that there was another state of consciousness which was not only mine but which was a common, which was the whole. And that this was better, this was the state which I called the world of light. Not then, but now in view of what I heard later. Whereas the ordinary world compared with that was the world of shadows.

**Wilkins:**

Yes. I get you. So that you and audience entered a new state of consciousness during the process of you talking to the audience.

**Bohm:**

Yes.

**Wilkins:**

That seems to me to make very good sense because it's somewhat equivalent to a group of musicians playing together and they suddenly find they've



attained some new level of musical activity by the nature of their interaction as a group.

**Bohm:**

Yes.

**Wilkins:**

I don't want to get back to it, but it seemed from our previous discussion about Bohr, that Bohr's thing was not really a unity of opposites because out of his discussion did not emerge any new concept of the totality. All you would say was, "Oh well, this is the totality. Full stop."

**Bohm:**

Yes. I think, probably, that's more or less the thought I came to later. But at the time, though, I was really carried away by this whole atmosphere.

**Wilkins:**

So that in fact, you mean, that you felt was the weakness in Bohr's position.

**Bohm:**

At that time, I didn't see it. But later I began to see it.

**Wilkins:**

It's interesting. It refers to our discussion some time ago when I was writing that little thing. That Bohr's idea doesn't really correspond to a unity of opposites and what you were after was the emergence of a new phenomenon.

**Bohm:**

Yes. Something new. All Bohr did was to explain. He would have said that this new quantum phenomenon was the unity of opposites is the way he would have looked at it.

**Wilkins:**

You can say the new wave mechanics or something all emerges out of it. But it's not really a very convincing statement.

**Bohm:**

No, at the moment I was carried away with it because Weinberg was a very intense, convincing person and since Oppenheimer was also behind it that gave it a lot of weight in my mind and so on.

**Wilkins:**

Yes, I must confess when I first started thinking about the complementarity, I mean, I fell into this sort of trap and I think most writers on this do. Capra and all these people always trot this out as though Bohr's complementarity between momentum and position has precise — Well no, maybe they don't go into unity of opposites so much.

**Bohm:**

They think of it as a creative, new synthesis of some kind.

**Wilkins:**

But it isn't all that creative, is it?

**Bohm:**

No.

**Wilkins:**

I mean, that's your point.

**Bohm:**

No. I think, I thought of it as creative but I gradually began to feel it was blocking me. For many years, I thought of it as creative, you see.

**Wilkins:**

Yes. Well it is creative up to a point.

**Bohm:**

Up to a point, but I probably got through that point.

**Wilkins:**

Yes. I suppose it must have been an immense relief to Bohr, and Heisenberg, and others once they got as far as they did.

**Bohm:**

Yes.

**Wilkins:**

I gather from the writing on it they were in a state of enormous frustration and misery over the lack of any kind of coherence in thinking.

**Bohm:**

Yes. They might have been better if they had stayed with the frustration. This frustration is a challenge which gives rise to creativity if you stay with it. But if you too quickly remove it?

**Wilkins:**

It is an inadequate approach.

**Bohm:**

Yes.

**Wilkins:**

Yes.

**Bohm:**

I think that was a matter of finishing up a few points that were raised last time. What I can say is that after having this experience and the let down and a long

period of not being able to work, I gradually got back to work. But by that time, Oppenheimer and all these people had left for Los Alamos and I wasn't allowed to come. I was rather isolated. I did manage to finish my Ph.D. degree doing a more restrictive problem that Oppenheimer had suggested. The scattering of neutrons and protons which involved a fair amount of numerical calculations. But I finished it and he apparently found some use for it at Los Alamos. It was branded secret. But I got my degree out of it anyway on his word in 1943.

**Wilkins:**

I got my Ph.D. in similar circumstances. I had the great advantage, I didn't have to go to a graduation ceremony.

**Bohm:**

I didn't even have to write a thesis. I just used the—

**Wilkins:**

I had to write a thesis. I took two paper manuscripts and put a few sentences in between and that was my thesis.

**Bohm:**

I think Oppenheimer more or less just had to sign a paper.

**Wilkins:**

So, you took it without even writing it out.

**Bohm:**

No. Oppenheimer signed a paper saying that it had been done.

**Wilkins:**

I think our exposure is a fraud, Dave. A big scandal that this great Dr. Bohm hasn't got a proper degree.

**Bohm:**

Because the document was classified. They probably were not allowed to look at it.

**Wilkins:**

You heard about this recent case of the most successful entrepreneur/industrialist in Sweden, Dr. So-and-So. And it recently came out that he didn't have a degree and there was a big scandal. He was

the big hero of free enterprise society in Sweden.  
Had you heard about it?

**Bohm:**

No.

**Wilkins:**

Oh, yes. Apparently he was doing enormous things in biotechnology and God knows what, and I'm not quite sure what happened. They think it may have been that he confessed himself that he hadn't got a degree. So evidently, his reputation is ruined or seems to be.

**Bohm:**

I don't think it makes any sense.

**Wilkins:**

I don't think it really matters very much. The man could do a successful job. I suppose, something to do with public morals.

**Bohm:**

I don't think it makes any difference.



**Wilkins:**

I don't think you need worry.

**Bohm:**

Well, anyway I got my degree and I began to work for the Radiation Lab. I can't remember when I did. I call it the Lawrenceberg Free Lab. But at first, I was not clear what I should do. They were working on ion beams, focusing ion beams to separate Uranium 235 in the Cyclotron.

**Wilkins:**

Were they only just beginning that?

**Bohm:**

They'd been doing it for several years. And in fact, several people in Oppenheimer's group had apparently worked out a formula for what they called "shims" to alter the magnetic field with little things they stuck in there to reshape the magnetic field so it was focused better. Actually, they were worked out mainly by Stanley Frankel and Alfred Nelson. They seemed to have done quite a good job while they were still here in Berkeley. They were

off, however, by then to Los Alamos. People began to ask questions: could you use electrostatic focusing and I tried to work something out? But I couldn't. There were a couple of questions. I studied the plasma during this time but I didn't know what to do because there was nobody else around that I could talk with.

**Wilkins:**

What was this plasma problem?

**Bohm:**

Well, it was merely that the arc was the source of the ions as an electric arc. And this arc was highly unstable and had all sorts of difficulties in it and never worked. It always fluctuated and never worked exactly the same. It was felt to be the major cause of the lack of focusing its irregularities. The ion beam had enough intensity to be space charged, but if it were steady, that would have been neutralized by negative ions gradually being chopped. But because it wasn't quite steady, it never did. As a matter of fact, the beam never quite focused as well as the Shim Theory suggested it should.

**Wilkins:**

I see. The thing is that the space charge thing which prevented the beam spreading, was not fully operative because the?

**Bohm:**

It was fluctuating.

**Wilkins:**

The arc was fluctuating. I didn't know that.

**Bohm:**

That's how I recall it; I may be wrong. But there were attempts to think of electrostatic focusing and also just generally to think about the arc. But there was nobody around to suggest what I should do at all and I merely tried to find something to do. But during this period I was somewhat discouraged anyway and there was nobody around. There were several people who were left, however, who had been mostly in the Royal Calculating thing. They didn't have anything for them to calculate. I don't know what they did.

**Wilkins:**

When did Massey and those people?

**Bohm:**

That was a bit later.

**Wilkins:**

That was before they came?

**Bohm:**

Before they came. I can't tell you. But shortly after I got my degree they must have arrived along with you, right?

**Wilkins:**

Um hmm [yes].

**Bohm:**

When did you arrive? Do you remember?

**Wilkins:**

No, I don't remember. I think it was wintertime.

**Bohm:**

It could have been about the winter of 1944, couldn't it?

**Wilkins:**

It was probably before that.

**Bohm:**

1943?

**Wilkins:**

More likely. Yes.

**Bohm:**

Yes.

**Wilkins:**

I suppose if I tried hard, I could work it out. But, you mean, when the other people like Massey came who were mathematical physicists, did this alter the situation as far as you were concerned?

**Bohm:**

Yes, because then I could begin to talk things over. Also, Massey had a team and was able to set up

some experimental equipment. Tomlinson or somebody was there and he had other people. He had some access too. He came along with more authority and he could get things done, you see. So, Burrup [?] was there. With Burrup I got along quite well. The whole thing began to pick up with Massey. They began to set up probes. They had an experiment where they set up electric arcs with argon just for studying it by putting probes in of all sorts, and finding out how it fluctuated and so on, and began to try to make theories of it. The plasma began to interest me. Plasma behaves like a substance which tends to maintain its state. If you put a probe into it, the probe is surrounded by a sheath that neutralizes it in a short distance. It seems the plasma is trying to prevent itself from being changed internally. It's almost like a living thing that maintains its internal state.

**Wilkins:**

You mean it's a little bit like an indeterminacy principle?

**Bohm:**

No, not that. Just simply, if you have positive ions that are quite heavy and electrons that are free and move easily. Now anytime you produce any change of potential, the electrons move so easily, they neutralize it. And therefore, you cannot set up a change of potential in the plasma. Now, if you do try, what happens is that the electrons near the probe are pushed away, leaving an excess of positive ions coming in and these neutralize the probe within a millimeter or a fraction of a millimeter sometimes.

**Wilkins:**

But presumably, if you put a very low potential indeed on the probe, then you might not disturb it much, is that right?

**Bohm:**

There are two possibilities. If you put a positive potential on the probe then you start to attract the electrons in and push the positive ions out and therefore you have an excess of charge. It's space charged limited. But then the probe will, in a short distance, be neutralized whether you put positive or a negative potential on it. If you put a negative potential on it, it will repel the electrons and the

positive ions will come in. It's very hard to get a positive potential on there because the current will flow —

**Wilkins:**

From the electrons.

**Bohm:**

Yes. But you can hold a negative potential. It will be surrounded by a very thin sheath. The plasma itself is almost unaffected inside. So, the plasma almost seems like a living organism that prevents foreign bodies from coming in, it surrounds them, and encapsulates them.

**Wilkins:**

The plasma then is simply an assembly of heavy positive particles and light negative particles.

**Bohm:**

Yes. The light negative particles generally have a temperature of about 10,000? or 20,000? or about 2 or 3 electron volts. The heavy particles are at a much lower temperature. Usually they don't come to equilibrium. There isn't time because the whole



thing will be swept away and new stuff created before that happens.

**Wilkins:**

Why are they swept away?

**Bohm:**

Up to the walls. The stuff is drifting and the walls will eventually take it up. So you have to renew it all the time by electric discharge.

**Wilkins:**

Yes. You mean the whole system won't just sit there. It has to be maintained by constant renewal.

**Bohm:**

That's right. There's recombination. But even more, there's stuff sweeping to the walls. Now, the plasma had been worked out by Langmuir and other people for plasmas which are not in strong magnetic fields. Not a great deal had been done with strong magnetic fields, so this really was a new problem. The point is, in the vertical direction along the magnetic field, the theory would be much the same as in the ordinary plasma because the electrons move freely

in that direction. In the other direction, something very new occurs.

**Wilkins:**

The electrons can't move very easily.

**Bohm:**

Yes. Neither the electrons nor the ions, and both are restricted but the electron is much more because their mass being small they move in much smaller circles. Now according to the simplest theory, they ought to move in extremely small circles. And therefore, diffusion would only occur if an electron going in a circle hit an atom, and then a new circle was started with a different center, and it would gradually diffuse. But the diffusion coefficient calculated that way was very small and the actual diffusion found in these arcs was very much bigger; hundreds or thousands of times bigger than that. So, that was the first extraordinary feature. In addition, it was highly unstable. One found there was always some sort of potential going on inside. Sometimes regular isolation and sometimes very irregular ones which were called hash. Whenever the arc became

hashy, then that was the end of the focusing because of the space charge problem.

**Wilkins:**

I'm trying to remember whether I remember the word hash. Maybe I didn't. I mean, I was only working on the experimental systems.

**Bohm:**

The experimenters used the word "hash" all the time. They were watching the oscilloscopes and saying, "Now we've got hash." Then they had to twiddle the knobs and try to get rid of it.

**Wilkins:**

I see. Do you remember that nice chap Allen? Did you ever run into him at one of the English parties?

**Bohm:**

I don't recall him.

**Wilkins:**

I met him several years ago at Redding when I went to give a talk down at Redding. He met me down at the railway station. He came up to me, and it was

just as though he had only seen me yesterday, and he started talking about the gravity waves he was working on. It was very nice after forty years or something to suddenly meet a chap again and there being no time interval at all. Sorry, I was interrupting what you were saying.

**Bohm:**

There were problems with these arcs. We did not directly try to deal with them but we were trying to build up a knowledge of how the arc works from which it was hoped that something could be gotten.

**Wilkins:**

To improve the operation of the equipment that was already being set up in large numbers at Dogpatch [?].

**Bohm:**

Yes.

**Wilkins:**

It was Dogpatch, wasn't it?

**Bohm:**

Was it Oak Ridge?

**Wilkins:**

Yes, I think it was Oak Ridge.

**Bohm:**

Yes.

**Wilkins:**

But it was called Dogpatch, wasn't it?

**Bohm:**

I didn't know that name myself.

**Wilkins:**

No? It was some sort of derogatory term.

**Bohm:**

We just said Oak Ridge. I don't know. But the idea was that we would study this arc systematically.

Massey was quite interested in studying the thing systematically and without immediately thinking of getting results. We had quite a good relationship. We would have experiments going on and watch them,

and then go out and come back with some calculations a little later and we could test our ideas. It was on a small scale so the whole thing could be done very easily.

**Wilkins:**

The equipment was very small.

**Bohm:**

Yes. It wasn't even compared with the Cyclotron, things like that. I mean, it was something you could get into this room quite easily.

**Wilkins:**

You mean you weren't putting your equipment into the big magnets?

**Bohm:**

No. We were doing things with arcs, first of all, using argon. There were smaller magnets around. I can't remember.

**Wilkins:**

You would make a model for the big system with a small magnet.

**Bohm:**

Yes.

**Wilkins:**

I didn't know that.

**Bohm:**

I can't remember how we did that, you see. The thing became more interesting to me. And then there was a fellow there called Bacchus [?] there, John Bacchus.

**Wilkins:**

Yes, I remember him.

**Bohm:**

He had some ideas about ion drifting. The point is, if you can get an electric field going across the arc, this will cause ions to drift perpendicular to the electric and magnetic fields much faster than they would move just by collision, changing the center.

**Wilkins:**

What makes them drift?

**Bohm:**

Because the electric field causes them to go in a cycloidal path in the presence of the magnetic field. And that cycloidal path is proportional in strength. It's only inversely proportional to the magnetic field. Whereas the diffusion probability is proportional to the square.

**Wilkins:**

So, you're putting electric and magnetic fields together, you get an especially fast diffusion.

**Bohm:**

A much faster diffusion, yes.

**Wilkins:**

Of the positive ions.

**Bohm:**

That's right.

**Wilkins:**

No one had realized that?



**Bohm:**

Yes. Both the positive ions and the electrons. It was well known that electrons would cross this magnetic field if they had tremendous currents of electrons flowing around the edge of the arc. But the positive ions will do the same in their own way and then there's a constant instability, so that you're getting electric fields due to the unstable plasma oscillations. And therefore the thing is drifting back and forth and around and getting a kind of diffusion. So, that diffusion was almost unpredictable. It could go into a hashy state when it was more into a regular state. This was the limit on how strong an arc you could get because the stuff would diffuse out too fast for you to get too intense an arc especially as it becomes unstable. There were regimes of stability and instability by changing various potentials. But there was no sure way to do it. This was so complex you could never be quite sure what was going to happen.

**Wilkins:**

In fact, this was done in the hexafluoride, right?

**Bohm:**

Yes. They did it and then people became skilled at operating the knobs so as to try to get rid of this instability. As a way of producing uranium, obviously, it had its drawbacks because this was difficult to do.

**Wilkins:**

But they already had mass production of this narrowed to Oak Ridge?

**Bohm:**

They went ahead anyway and the thing did work, actually, well enough to produce some uranium. But obviously, that was not the way which they followed up.

**Wilkins:**

No. They made one bomb out of that, didn't they?

**Bohm:**

I'm not sure where the source was. There was also a diffusion project to make it.

**Wilkins:**

So, you think the Hiroshima bomb was uranium.

**Bohm:**

Yes. But I don't know how it was made.

**Wilkins:**

It could have been diffusion.

**Bohm:**

And not this one.

**Wilkins:**

I didn't know that.

**Bohm:**

I once knew that but I have forgotten it.

**Wilkins:**

Not that it really matters much. The diffusion process was on some other site?

**Bohm:**

Somewhere in Washington, I think. I can't remember. Maybe it was somewhere else. But we didn't know about any of this at the time, at least I didn't.

**Wilkins:**

You had heard of Oak Ridge, of course.

**Bohm:**

I had heard of Oak Ridge but not these other things.

**Wilkins:**

Yes. For secrecy reasons, only the very top people knew what was going on in the total project.

**Bohm:**

Yes. The plasma became very interesting to me. I could see that this was a kind of analogy to the problem of the individual and the society. You had in the plasma what I called collective behavior, that is, oscillations. Every plasma can oscillate. When all the electrons move together, they produce an electric field that draws them back so that they'll oscillate. They oscillate in a coherent way which belongs to the whole. I call that a collective movement.

**Wilkins:**

Yes. You mean to some extent it's a little bit like a liquid drop oscillating.

**Bohm:**

The difference is that it's not due to contact but it's due to long range forces.

**Wilkins:**

Electric forces at a distance. Yes.

**Bohm:**

And therefore the frequencies are different and so on. Now, you had the plasma oscillations which were discovered by Langmuir. You also had the ion plasma that could oscillate but these had a different way oscillating because they were highly modified by the electrons. But the electrons are not normally anywhere near rest. They were moving in a random way with quite high random velocities corresponding to 10,000(?) or 20,000(?) K.

**Wilkins:**

You mean the random motion was the heat motion.

**Bohm:**

Yes. The electrons had a fairly high temperature because they were liberated from the discharge.

Therefore, it wasn't quite so simple to make a theory of oscillation. It was not quite so simple as thinking of an electron in a certain position. And any oscillation, the electron could move quite far. The question was how was this collective motion maintained in spite of the random basis of the electrons? You see, this was the kind of interesting social question. It was rather like society, everybody moving in his own way and you have certain social, collective tendencies still exist.

**Wilkins:**

Yes, yes. I suppose Mrs. Thatcher would say that everybody's moving in their own different personal directions and it will all add together.

**Bohm:**

Well, that was the theory which I made. The point is, every electron moved on its own but it was somewhat influenced by the collective whole, the whole field, which was long range. And the sum of all these influences produced the long range collective field. So, it was a self-sustaining motion in such that each electron had its freedom, apparently, to do whatever it would do. But

nevertheless, because of the effect of the collective long range effects, each electron was modified a bit and was able therefore to add together to produce the very collective motion that we have assumed in the first place.

**Wilkins:**

So the key thing was the nature of the collective, long range effect.

**Bohm:**

Yes. That's right. So, I saw that as a model of society where I wanted to begin to understand the relation of the individual and the collective. Where one did not greatly interfere with the individual freedom and yet one could understand collective action.

**Wilkins:**

Yes. But I mean, in a society, what is the nature of this force?

**Bohm:**

Well, you can see the nature of it as people are affected by each other, by whatever they do, the

information, the ideas, all sorts of ways they're influenced by the state of the society. So each person is somewhat affected by the general state, which he becomes aware of, and he moves somewhat directed toward that.

**Wilkins:**

One can see that there is this sort of general attitudes and things in society. But surely the point, the essential difficulty about society is that these forces don't act in a sufficiently clear way to guide people sufficiently so that they will work together. I mean, that's the essential weakness, isn't it?

**Bohm:**

Well, this was the beginning. To say that one found in the plasma that it was only necessary because of the long range effects to have a slight effect on the particle and to add up to produce a large collective effect. Now, that would be a model for some forms of collective action.

**Wilkins:**

Yes. But in the physical model which you have there, you have defined electrostatic interactions and



so on, and you could see that you could get a large degree of coherent behavior, couldn't you?

**Bohm:**

Yes. But that result was coherent though the individual behavior was not.

**Wilkins:**

Yes. But I think the point is that in the physical model you can hope to attain a large degree of coherence in spite of the individual movement. Whereas in society?

**Bohm:**

Well, in some phenomenon in society you do. For example, all the statistical measurement and trends and tendencies. I mean, people doing all sorts of complicated things but a certain coherent tendency emerges and the very existence of that tendency influences the people enough to sustain it.

**Wilkins:**

I suppose you're right. It is wrong to say that society is simply a lot of chaos and fragmentation. There is the other element a degree of coherence. You mean

simply, like running a railway system or something. There you have a large degree of coherence that everybody's somehow aware of the fact that their jobs, their individual thing will fit into it, won't they?

**Bohm:**

Yes. There is also another way. Let's say you take what's called market forces. People who buy, each one is interested in his own purpose and they buy various things. Now, all sorts of different people buy in different ways. But they may be somewhat affected by certain common things, not only including advertising but also the common needs and so on. Also, trends arise when a lot of people buy certain things and other people start buying it just for that reason. And therefore, you may find a systematic trend in the market, though each person has no apparent compulsion to do anything. Or even in choosing political leaders, again, you find that sort of thing going on.

**Wilkins:**

You mean forms of behavior, mental attitudes.

**Bohm:**

Yes. I think that was the model for quite a few activities of society where some collective tendency existed and yet, there was no compulsion on the individual to follow the collective form. Now, the point is not to say it was a complete theory of society but it was rather my first attempt to see how the individual and the collective are related.

**Wilkins:**

Yes. But on the other hand, you would now, of course, emphasize that the problems of society are due to the fact that there are levels on which this type of process does not operate.

**Bohm:**

Well, society is obviously far more complex than a plasma. Even in a plasma there are maybe limits to how this analysis can go.

**Wilkins:**

But presumably, the utopian thinkers are always looking for some kind of principle which will

operate in society which will join people together with a much higher degree of cohesive behaviors.

**Bohm:**

Yes. Although I was strongly considering Marxism, there was still remnants of the earlier individualistic approach. So I had reached a stage. I thought of this as a certain opposition between the individual and the collective leading to a synthesis. The long range forces tended to favor a completely collective domination of behavior if they won out. Now, the random motions tended to break that up and favor the individual. And so, a synthesis came out in which you had the individual moving fairly freely and yet the collective appeared.

**Wilkins:**

You mean the model, in effect, was an example of a unity of opposites because it had special plasma properties emerged out of this system.

**Bohm:**

Yes. Dynamic plasma properties of all kinds. The oscillations being only one of them. There were a great many others which began to come out. One of

the interesting questions that came out was this: how can these plasma oscillations be excited? Because this had to do with stability or instability. In other words, if it's unstable, if a small plasma oscillation would tend to grow the system is unstable which would be disastrous from our point of view. People wanted to focus the beam. So, the point was that if you had special beams of particles at a certain velocity going through the plasma at a speed close to the speed of a plasma wave, then they could excite the wave.

**Wilkins:**

By plasma wave, you mean, is this other type of coherent motion.

**Bohm:**

That's right. So most of the particles which are supporting the wave are going this way and that way and not related to the wave at all. But now suppose some special particles come along that happen to be moving near the speed of the wave.

**Wilkins:**

Like pump priming. You put a little bit in to set the whole motion going.

**Bohm:**

Yes. These special particles will play a special role because they will stay in phase with the wave and keep on pushing on the wave and building it up or else damping it depending on how they are put in. And therefore, it was an interesting question saying that there could be individuals in a special role to the collective which would arouse the collective motion or else damp it. So I found it an interesting point that some individuals in a special relation to the society could play a particular role of starting to energize the social dynamic or else de-energizing it. This was also the idea of creating motion patterns and motion. A little bit like the idea of the tornado being a pattern of motion created.

**Wilkins:**

Yes. It's a little bit like quality emerging out of quantity.

**Bohm:**

This was a kind of dialectic between the individual and the whole or the society, rather.

**Wilkins:**

Had Weinberg gone by then?

**Bohm:**

He wasn't in the radiation lab. They hired him for a little while and then they sort of didn't hold him and he went back to teaching physics.

**Wilkins:**

They didn't like his politics, was that it?

**Bohm:**

Yes. So I never discussed this stuff with him anyway. But I don't know how interested he would have been. I worked out some sort of formula for the diffusion coefficient in a plasma as a function of the electric field, the magnetic field, and the temperature of the ions and so on. Eventually I worked out some theory of sheaths formed in the plasma and the tendency of the plasma. I went further into the

theory of how the plasma screens any disturbance and so on and protects itself. That was eventually published a number of years later. We put it in a report and that was all. But some of that material was published in a report later and this was taken up by the people working on fusion because they faced exactly the same problem.

**Wilkins:**

They wanted to contain the thing.

**Bohm:**

In the magnetic field wouldn't stay because of this instability. They found this formula, which I — By the time it came out, that part wasn't included.

**Wilkins:**

If you had been publishing an actual paper that you might well have thought of making him a co-author. You had done the bulk of the work.

**Bohm:**

Well, at least we could refer to him as having helped to suggest the idea.



**Wilkins:**

The fact that you had done most of the work on it, his role rather got lost sight of.

**Bohm:**

Yes. But anyway, it doesn't make any difference to me because I never pursued that line further anyway. See, that was a period where I was feeling quite interested. As you recall, we went on this trip to the Sierra's during that period. Was that Emerald Lake or something like that?

**Wilkins:**

Tahoe.

**Bohm:**

No. It wasn't Tahoe. It's near Tahoe. It's a small lake near Tahoe. Emerald Lake, I think it was called.

**Wilkins:**

Was it?

**Bohm:**

Yes.

**Wilkins:**

It was near Tahoe?

**Bohm:**

It was not Tahoe itself. Tahoe is a much bigger lake.

**Wilkins:**

I see. It's like this thing. We couldn't find where to turn the water on. Do you remember that?

**Bohm:**

Yes.

**Wilkins:**

It's always a matter of getting something to flow through pipes or along wires or something.

**Bohm:**

That was quite an interesting period. Finally, however, the English contingent left but I don't remember exactly when.

**Wilkins:**

That was after —

**Bohm:**

After the bomb went off.

**Wilkins:**

Yes.

**Bohm:**

When was it? In 1946?

**Wilkins:**

It was August 6th.

**Bohm:**

1945 was it?

**Wilkins:**

1945.

**Bohm:**

But they didn't leave until a little later than that.

**Wilkins:**

Yes. Well, we went on for some time. After the Japanese surrender which was very soon after the Hiroshima bomb, the whole thing began to grind to a halt, didn't it?

**Bohm:**

Yes.

**Wilkins:**

I still have some of the newspapers, you know, from San Francisco area saying about this immense trial and all the scientists being congratulated on this immense success they had.

**Bohm:**

Yes. I remember the general feeling at the time. I think everybody did feel really good that it was a success. People still hadn't thought of its implications yet. It was felt that it had helped to end the Japanese war. Originally it was done because we had thought maybe Hitler would have it. But then it was said that it would end the war more quickly, which I'm sure it did. And of course, I think there

was this pride in having liberated this energy. Because what I can recall is that in the early days, especially before the war, physicists were looked down on as rather inconsequential beings who didn't deal with any serious, practical things. They could never do anything.

**Wilkins:**

You mean, that was in American society?

**Bohm:**

Yes.

**Wilkins:**

Maybe this was less so in Europe with Albert Einstein and so forth.

**Bohm:**

Yes. It probably was less so. They looked at it with awe in one sense. They were dealing with such difficult things. But on the other hand, I think people said, "We are the practical ones. We really do things."

**Wilkins:**

The engineers.

**Bohm:**

Yes, engineers and businessmen and so on. And remember that Lawrence told me that when this bomb went off in Alamogordo in New Mexico, General Groves was around and he was surprised. He said, “By God, the long hairs have done it!” Apparently he didn’t really think it was going to work.

**Wilkins:**

The long hairs.

**Bohm:**

Yes, the intellectuals. There was the general impression among the Army and many practical people that people who were intellectual were up in the air, they couldn’t really do anything.

**Wilkins:**

Yes, intellectuals would be knocked down to earth.

**Bohm:**

Yes. So I think that physicists must have felt glad that at last this shows that we can do something. It really works.

**Wilkins:**

The other thing, I suppose, was that we were all very heavily conditioned at that time to thinking in terms of military victories being a good thing. And I remember looking at newspapers, which I had at various times in the War, I think, or one following the Russian front. And when you saw headlines about two hundred thousand soldiers being killed in a battle or something, you didn't feel any special feeling of horror, you just thought, "God, was it a victory or was it a defeat?" Was the frontline moving this way or that way?

**Bohm:**

Yes, that's the way one looked at things. I remember in Stalingrad, I was watching that line in the newspapers all the time and feeling good if it was moving westward and bad if it was moving eastward.

**Wilkins:**

I remember that, these diagrams round Stalingrad. And I think that one had got immune after several years of following the War to thinking about the horrors of what was happening. You were just looking at how the line was moving. And I suppose a little bit like a surgeon who very soon is no longer upset by the blood. That they have a job and they get on with it and they don't get upset. I think this may have been part of it, you know. But look, can you remember at that time after you heard the bomb had gone off because presumably we heard about the Hiroshima bomb before we heard about the test in the desert, didn't we?

**Bohm:**

Yes. I never heard about the test in the desert.

**Wilkins:**

That was kept secret through the Los Alamos people.

**Bohm:**

Yes.



**Wilkins:**

It was only a few weeks before, in any case, wasn't it?

**Bohm:**

I don't know.

**Wilkins:**

I don't think it was terribly long.

**Bohm:**

No.

**Wilkins:**

Did you have any particular feeling of horror or anything?

**Bohm:**

No because you see in that context, as you were saying, battles involved tremendous numbers of people being killed. We knew of firebombs in Germany which must have produced real horrors too.

**Wilkins:**

It killed almost as many people.

**Bohm:**

Yes, so it didn't seem there was any fundamental difference. If it would win the War quicker, it was legitimate.

**Wilkins:**

Yes. And I think that the firebomb raids in Tokyo might have already —

**Bohm:**

Worked.

**Wilkins:**

Yes, I think they had probably taken place already.

**Bohm:**

They had taken place, yes.

**Wilkins:**

It wouldn't have taken place after the atomic bomb.

**Bohm:**

No, not after. There had been firebombs in Tokyo and then Hamburg.

**Wilkins:**

I think that actual number of people killed was bigger in Europe than in Hiroshima or Nagasaki.

**Bohm:**

So, there had been firebombs all through in Germany and in Japan. So, it seemed it was really just an extension of what had been going on.

**Wilkins:**

Yes. And the actual numbers killed were no less than in previous raids.

**Bohm:**

One didn't realize the full implications of where it would lead. And therefore it wasn't unduly alarming and it was felt, well, at least this would end the War.

**Wilkins:**

Yes, I am interested in what you say because I, you see, have a very distinct memory. Do you remember Ken Simpson?

**Bohm:**

No.

**Wilkins:**

The philosopher? He was the one who designed the big vacuum pumps and he had been a philosophy teacher at some university. A nice chap. I got to know him quite well. And I remember that day after the newspapers were full of all this news, going down to see him at his house, he and his wife, they didn't have any children. And I found him in a pretty depressed state. He said, "This is Black Monday." It was a Monday. Actually, strangely enough, the desert test was on a Monday too. Then I remember sort of adjusting to these things, thinking, "Well, yes, he's right, isn't he?" And I felt slightly ashamed of myself that I hadn't been upset too. I had a respect for his general judgement, and so I got the message from him but was quite quickly converted to his point of view, that this was really a very horrifying business. And that the idea that the project had been

successfully completed and the bomb had worked and done its job and so forth fairly quickly tended to recede into the background. This whole visit to him because I don't know that I had any particular reaction to it at all, the bomb had gone off and there was relatively little value judgment involved in my reaction. This was a fact and I was aware of this fact. But, was it a bad fact, was it a good fact, or what. It was from him.

**Bohm:**

Did he realize not only the question of radioactivity but also that proliferation was at stake?

**Wilkins:**

I don't remember. But I think that he had some sense of the enormity of the whole thing that I think he must have a little bit like Niels Bohr, who came, of course, very late on the scene. That he wasn't so involved that he saw the wider social, political implications and also possibly strategic implications of the bomb. Now this would be in the nations' arsenals and so on and God knows what might happen. But the other thing I think about it is, why was Simpson especially [upset]? Clearly, I had

talked with other people on the project during that day before I saw him. Why was he different from the impression I got from the others? And I think it might have been two things. One, he wasn't a professional physicist, you see. He was a philosopher and he was just doing engineering work in designing vacuum pumps. The other thing was that he may have had a wider sense perspective, moral and political and philosophical, than I had. And I think he was that type of person anyway and I think that's why I found him interesting. And we used to talk quite a lot over lunch. I remember one discussion I had with him when I said I had always felt a bit aggrieved that my father was a very good swimmer and high diver and everything and never taught me to swim. He had various sort of worldly sophistication about wines and evening dress and things like this that I had all been left completely in the dark about these things and felt a little bit deficient. But he had spent a lot of time taking me out in mountains and the air and walking in the country. And I learned a lot from him in that respect and Ken Simpson said, "Well, maybe it was really much more important to you that he educated you in relation to the mountains and the air and the sky,"

then he did about the evening dress and wines or even learning to swim. And I thought maybe he had a point. But I think the point that I'm going on a little bit is the nature of one's overall mental set, how one will react to a particular piece of news. And once I had gotten the message from Ken Simpson, it was pretty clear in my mind that there was certainly a very negative aspect, the Black Monday aspect to it. What was your own impression? After a few days or weeks went by and discussing it with other people, it was in all the newspapers, did you start realizing the very negative aspects of the whole thing.

**Bohm:**

I don't know that I got very far in that.

**Wilkins:**

Even if you didn't analyze it. I mean, he just said, "Black Monday" and this was an overall attitude. Somehow, this is dreadful without necessarily defining it.

**Bohm:**

There are two things. One realized that the scale was very bad. We didn't know about how radioactive the thing was really. There was a feeling of danger that this would, say, tempt some people to go to war to defeat the Soviet Union quickly. But you see I think that we were thinking in terms of trying to get some sort of international cooperation on this. It wouldn't be that dangerous if people could agree. Remember, the Russians were still allies and so on and it didn't seem out of the bounds of possibility that there could be some cooperation.

**Wilkins:**

Yes, I see. So you weren't too alarmed by it. I think, incidentally, about the radiation that Peierls and Frisch in their original paper calculating that a U235 bomb could be made without very much uranium, did set out and gave a proper discussion about the biological effects of radiation. It was really serious.

**Bohm:**

Also the fallout, which one hadn't thought about.



**Wilkins:**

Yes. I don't know. Maybe I should look it up; presumably it's been published.

**Bohm:**

I think it would have been impossible to predict the degree of fallout.

**Wilkins:**

You mean the two elements to the radiation. You mean the instantaneous radiation and the longer term.

**Bohm:**

And then also there was a feeling that nuclear power, its peaceful uses, might open up great possibilities. It wasn't, at least to most of us, clear that it was necessarily a tragedy. One could see there were dangers there.

**Wilkins:**

Yes. I think it might well be partly that Simpson wasn't a physicist. We were the big boys, the physicists. We showed what we could do. As a

philosopher, he wouldn't have felt quite like that, would he?

**Bohm:**

Well, I think it would have to do with some assessment of the human situation. It would not be dangerous except given that human beings cannot be stopped from going to war. Otherwise, there was no reason that we didn't think of the dangers of peaceful atomic energy at the time.

**Wilkins:**

I think that's quite true. Nobody, I think, thought about that. They thought there was going to be free electricity.

**Bohm:**

There was a sort of a feeling maybe at last this whole business of going to war could be stopped. The reason why atomic energy was so dangerous was just because human beings could simply not control themselves no matter what they decided to do, they end up doing things they have no notion of how they got into it.

**Wilkins:**

We saw it as a decisive weapon.

**Bohm:**

Yes with all sorts of decisive possibilities for peaceful uses. There was still the feeling that poverty was the main cause of the trouble and if we could eliminate that, we could have peace.

**Wilkins:**

I don't know. With a European background, one had rather less optimism about that than possibly American intellectuals might have had. I don't know. But look, tell me another thing. I have absolutely no memory that with the fall of Nazi Germany anybody raising the possibility that one ought to stop working on the project.

**Bohm:**

Yes. Well, some people apparently did.

**Wilkins:**

Who? Anyone at Berkeley?

**Bohm:**

Not at Berkeley but I mean Wilson and people at Los Alamos. A few people objected to going on, I think.

**Wilkins:**

There were very few. I think the only person who went off the project was Joe Rotblat of Pugwash. Margaret Garrity in her history of it states that that was because he had never been on a good research program anywhere. He had been sitting around there feeling frustrated.

**Bohm:**

I think there was the momentum of the project and also, you know, the argument was, I suppose in the back of the mind was, that it would be used in the war in the Pacific. I mean, it was implicit, wasn't it?

**Wilkins:**

You know, Groves is definitely quoted and there seems to be no doubt about this. Rotblat swears that Groves said to him this, that they had to finish the

bomb quickly because it was against the Russians that they had to —

**Bohm:**

Well, I remember Frank Oppenheimer had that notion later. He said that many people felt but there was also another aspect to it —

**Wilkins:**

He was sympathetic to the Russians, you mean?

**Bohm:**

Yes, Frank Oppenheimer was. But Frank Oppenheimer was afraid, possibly, of his brother that the bomb would not be used, would be kept entirely a secret, and then would suddenly be used in a new war.

**Wilkins:**

You mean against the Russians?

**Bohm:**

Yes.

**Wilkins:**

But Groves was very definitely looking forward to the opportunity.

**Bohm:**

I'm sure there was quite a few who thought of using the threat. One can understand. The fear of the Russians was behind the reason why the Nazis had been allowed to get as far as they got, really. They could have been stopped quite easily in the early days.

**Wilkins:**

Yes. If they hadn't feared the Russians, there would have been a united front against fascism and could have been stopped in its tracks.

**Bohm:**

But it's a very complex thing in the sense that the Russian behavior did not inspire a lot of confidence.

**Wilkins:**

You can put it another way, they simply were, on a simple class basis, I mean, the capitalist countries

didn't want abolition of their system which they saw the soviet system as a threat to it. That's an odd way of looking at it.

**Bohm:**

Yes. These people didn't want the soviet system. Now the point that people are more liberal who might have taken a different view when they saw what was going on, some of the nasty things one heard about the soviet system. There was very little opposition to these people, you see. In other words, there might have been people who would have felt, we must oppose this, but the opposition was halfhearted at best because there had been so many nasty things, even in the early years, long before the revelations of the 20th Congress.

**Wilkins:**

Yes. Well, I think the position in Europe was, 'round about 1935, the show trials were beginning and some people were beginning to have doubts about the whole system under Stalin. I think it was those things that were worrying. I think a lot of people, left wing people in Cambridge that I knew, including myself, the general attitude was that it was very

difficult to understand all this extraordinary business of these people making confessions and one still can't really understand.

**Bohm:**

There was enough pressure to make them confess. Partly it was their duty to confess, they were told, to propagate socialism.

**Wilkins:**

It is still a peculiar phenomenon. But anyway that was beginning. And of course, some people were ready to accept the evidence for what it turned out truly to be. But people who were more committed communists were very reluctant to do this and were prepared to go along with this and cover up for these deficiencies which were beginning to appear in the soviet system. But it varied about how generally sympathetic, some people, of course, were completely attached to the soviet model and thought it was the solution for all human problems.

**Bohm:**

I think, you see, you did get a considerable decrease in the enthusiasm for people to try to do something



different. Even in Spain, there were statements that the communists were fighting the others. And also that they had the attitude when the Nazis were coming, it was better not to help the center but let the Nazis win and then they'd take over later. You know, that there was such, that all these things going on, it left a bad impression.

**Wilkins:**

Well, the Nazi German-Soviet pact made a bad impression and I think quite a number of people who had been communists in England just gave up at that stage.

**Bohm:**

There were things I used to read in the New Republic saying that the Soviets, the Communists in Germany had sort of not really resisted Hitler in the sense they thought that if they could let this thing weaken, the center, and then it would speed up the revolution, you see.

**Wilkins:**

Yes, the communist revolution.

**Bohm:**

There were a great many things which meant that they had very little support except from the extreme far left.

**Wilkins:**

Yes, I think it's difficult to assess this. I mean, they're now arguing in the newspapers about what happened in Greece and to what extent the communists were sensible there. And of course, it goes on and on about who really fought Franco in Spain, was it the communists or was it more the anarchists and so on who were put down by the communists. But I think, at least what one knows in the occupied countries during the war, I think, the communists did take a leading role in anti-fascist control there.

**Bohm:**

At a certain point they did but when it became clear that there was no other way. The whole thing was such, the theory was such that the thing of bringing about socialism was the main point and therefore any move that would favor that, they would do. Now

one of the ideas was the principle barrier to socialism was, say, the moderate left or the middle. And therefore, they wanted to bring that down. But at the same time, they had a policy of a united front which was not entirely compatible with that. By these sort of contradictions after a while, it began to make them lose their credibility, you see.

**Wilkins:**

Yes. Going back to this whole question of the scientists being hooked and addicted to the pleasure of intellectual pleasure and satisfaction of doing their work. Brian Easely in his book about the history of this gives extensive quotations from people on the Los Alamos project. And he seems to have assembled a very good case there that for this addictive element. Mind you, it may be better to say obsession because addiction means you can't stop and you also take too much of it. But the important thing was they couldn't stop rather than they were working too hard, they couldn't stop to think. And I think the various accounts that people have given about the euphoric reaction to the successful test down there do seem to point to that. My own feeling is that this phenomenon does link up with the

question of the weapon scientists today that they do, to an extent, find their work exciting. The challenge of the work and this does tend to intoxicate them a bit. So, they tend to become blinded to the wider issues. And it's a bit similar, I would say, to drug addiction. But I think you have to be rather careful in putting it in abusive terms like that to scientists or you get their backs up. But I think it is a real problem. And it does seem to me, to a fair extent, that my own experience in Berkeley and from what you say, it does give some degree of support to that thing. And the fact that Niels Bohr was supposed to, when he went over there and found out everything they were doing, it's been claimed that he was rather horrified that no one was thinking about the long term consequences of the whole thing. When people raise doubts about the morality of working on the bomb, one of the things I always say is, "Well, at least one thing is certain, was the scientists working on the project were deficient in not giving more attention to the long term implications of the work. But at the same time, I think to be fair to them, it wasn't very easy under the pressures of all that work for them to be sitting down thinking so far ahead."

But I think if you want to criticize them, I think one could make that criticism.

**Bohm:**

Well, yes, certainly that's so. There was the fascination of the work and the realization of the dream of power and so on, which carried people.

**Wilkins:**

I think what you say about the physicist being looked down on and wanting to show they were big boys and valuable members of society and so on, this is a slightly new angle which I hadn't appreciated. And I think you've probably got a good point there because so many American universities had grown out of agriculture/engineering colleges and so on. And what you say also about Oppenheimer being a great, white hope as a theoretical physicist that these more esoteric aspects of physics were less developed in the United States than the more practical experimental side. It is a sort of a cultural difference.

## Bohm:

Anyway, that was the end of that era. I left out one point, during the War period while Massey was there, there were several problems that I was working on. One problem that Oppenheimer had left me with about trying to understand one of Dirac theories. Dirac had made a proposal about a theory to deal with the infinities of quantum electrodynamics which had negative energies and negative probabilities. I spent most of the War years in my spare time, pondering over that trying to make sense of what Dirac did. I think I got it fairly well organized because after the War I put out an abstract for the Physical Society. On the basis of the abstract, I think Wheeler became interested in me and I got an offer from Princeton. But of course, just about that time after the War, Oppenheimer said, well, Dirac was no longer interested in it so it's not worth pursuing. And I felt a little uneasy about that, why I didn't feel that was quite a good enough explanation of why it was not worth pursuing. I mean, I still had such admiration for Oppenheimer that I didn't really question him on it. That was one line I worked on.

**Wilkins:**

Was Dirac still at Cambridge then?

**Bohm:**

Yes, I think he was. The other line I worked on, I was very interested in infinity as a field theory. The fact that field theories give infinite results. You know, you had so many problems there. So, I had an idea that if you use the perturbation theory, you'll find not only energies and various properties come out infinite, but the wave function itself is infinitely changed. It should be normalized. Say it's indrick [?] was one, but it turns out it's not normalized after you use this theory, these approximations. So, I made a proposal that suppose in each stage of the approximation, you renormalize the wave function to 1 and then you would come out with a finite results. So, I sent this off. I wrote it up. Massey seemed to like it and also Weinberg liked it. And I sent it to Physical Review and finally received an answer which was very negative saying, "There's this problem." They didn't like this, they didn't like that. "If you'll correct all this, then perhaps we'll publish it," instead of saying it's not terribly

significant. So I felt that if they felt it was that uninteresting, I didn't feel that I wanted to bother rewrite the article. But I mean, Weinberg told me later that he thought that was a mistake. He thought that was the germ of this renormalization theory, which people went in for later.

**Wilkins:**

Which Weinberg was that?

**Bohm:**

Joe Weinberg. This fellow at Berkeley. So, I think probably I shouldn't have paid that much attention to the criticism; I shouldn't have taken it that seriously. I somehow learned something which suggests that Pauli had been responsible for that. When I wrote the article, I had no idea what happens to these articles in the Physical Review and what basis anybody would do anything. It was the first one I had ever written. But I learned later that it was probably Pauli because there was nobody else who wasn't working on War work.



**Wilkins:**

You mean, Pauli was the man who —

**Bohm:**

Refereed.

**Wilkins:**

— refereed the thing. It was negative?

**Bohm:**

Yes, but since then, he's been negative to all sorts of good ideas including Salam and a lot of other people. But I thought I'd mention that, it sort of completes the line of things that I was interested in during the War years. But I was maintaining an interest in quantum and properties of quantum theory and particle electrodynamics at the same time that I was interested in working on the plasma.

**Wilkins:**

Coincidentally, you said earlier about how you always felt with any sort of idea in physics to be valuable, you had to have some sort of general, more or less, physical sense of the thing. And the fact that

you could write down a formula and manipulate it and it made mathematical sense, didn't impress you necessarily all that much.

**Bohm:**

No.

**Wilkins:**

Now in that connection, do you remember what Einstein said? He certainly said that his new ideas often came to him in the forms of images. For example, visual images. I think I may have a note at home but did he say something about muscular images?

**Bohm:**

Yes, the feelings in the muscles was one.

**Wilkins:**

The feelings in the muscles. Yes, because I was talking with an American philosopher in Moscow about this and he said, "Well, that's very funny. Very strange. I can see how if you were excited about a physical idea that you might have a feeling in your muscles. But for there to be an

isomorphism,” was the word I think he used, between the feelings in your muscles and the intellectual idea, interested him very much. And it seemed to him a very strange notion. And I said, “Well, to tell you the truth, I can’t remember the exact words,” and I’ve been meaning to check up on this by going back and looking, because it is strange, isn’t it?

**Bohm:**

Well, not necessarily. You see if you think of the nature of thought, which is that it is a reflection back of the impulse to act, you see. That the first thoughts must begin with images formed by the infant which are not merely visual images but muscular. You see, you have what is called body image. For example, if somebody’s arm is cut off, he still feels he has it, right? So evidently there is in the brain an image of the whole body.

**Wilkins:**

Okay, that sounds very reasonable. I agree with you that you mean the whole relation between the thinking and the bodily sensation is derived from

analyzing the way in which thinking develops as the child develops.

**Bohm:**

Yes, that's right. His first thinking is, as Piaget says, it's sensory-motor thought, he calls it.

**Wilkins:**

He does, does he?

**Bohm:**

Yes.

**Wilkins:**

So the idea is there in Piaget. But I think, you see, this philosopher didn't know that and you can see how many philosophers would think that you have the body and the mind being very separate, you see. And in that way, they would find this isomorphism very odd.

**Bohm:**

But it's very natural. The point is, the thought has begun there in the image of the body.

**Wilkins:**

All I'm saying is, you can see how philosophers who hadn't thought through some of these things with the mind/body dichotomy would think it strange. But I agree with you. My own general reaction was, well, I didn't feel this dichotomy was all that real anyway, so why should it be such a problem. But I can see that for some philosophers. But anyway, you say this thing had been thought through by people like Piaget.

**Bohm:**

Well, he says the childish first thoughts are sensory-motor. They have to do with the senses and the motor activity and it's only later that he forms abstract thought after he gets language and so on.

**Wilkins:**

Yes. You mean that the thoughts are controlling the movements.

**Bohm:**

No, they are the movements. The thoughts and the movements develop together; they're a part of each other.

**Wilkins:**

You mean it's like learning to ride a bicycle or something.

**Bohm:**

Yes.

**Wilkins:**

But I think it's interesting the way the philosopher reacted that I think he was still sort of stuck in this dichotomy thing. I had been meaning for some time in various discussions to check up on this whole business. But I think what Einstein says is a little bit different from what you say because I thought that the way you felt more was that you wanted to be able to have some kind of image of say billiard balls running around or clouds of dust moving or something like that. Whereas Einstein was saying much more it was a matter of internal muscular feelings in his own body.

**Bohm:**

Well, I don't think it was all that different because I had the feeling of how these things move, not merely visually. A sense of their inertia and so on. For example, that's something I would say after I learned quantum mechanics, all throughout this period in Berkeley, an image kept on coming up to me about spin of a particle. Say it could 0, 1, or -1 but then by some linear combination of those wave functions it could be a spin in another direction somewhere in between, that was a basic quantum mechanical feature.

**Wilkins:**

A change in direction?

**Bohm:**

You could say the spin could be +1, 0, 1, or -1 in the Z direction, but if it's measured in another direction there's no way to visual how that could be, you see. But formally, mathematically, if you make a linear combination of the wave functions, you combine two wave functions of spin 1 and -1 and you can get a wave function of spin and definite spin, in say, the

X direction instead of the Z. Now, it seems that this was a very creative principle in the sense that from two very different things, like two opposite spins in the Z direction you got something new, a spin in the X direction. Then I used to get the feeling of that in myself. To say I got a feeling of something that spin in the Z direction and combined with a minus Z and then becoming a spin in another direction. See, I had the feeling that internally, you participate in the movement which is the analogy to the thing you're talking about.

**Wilkins:**

Can you articulate the nature of this feeling you had in your body, so to speak?

**Bohm:**

Well, I can't really articulate it. It had to do with a sense of tensions in the body and the fact that two tensions in opposite directions could be the equivalent of suddenly feeling that it's something else.

**Wilkins:**



Does the fact that the bimetal strip, does this help at all? Is that an analogy, where you have two forces acting, contraction and an expansion, but a displacement. The fact that they're displaced means the thing curves but, I mean, is that an equivalent?

**Bohm:**

Well, it could be a vague analogy. You see, the spin thing, you can't reduce to classical physics. The idea was that two feelings in the mind combine to produce something else which is of a different quality. I got the feeling of it.

**Wilkins:**

Isn't that a bit more a unity of opposites, then?

**Bohm:**

Well, it's not unity of opposites in the usual sense, no. It was something which I can't explain but the idea was that the constant in mind was going spin up, spin down. I got the feeling spin up; I was sort of spinning up. Then spin down. And then I was bringing them together and then spinning in the X direction.

**Wilkins:**

I must confess I don't understand the thing up and the thing down. If you were spinning and you say something about the wave function.

**Bohm:**

There's no way to understand it. I was trying to get an intuitive feeling for it.

**Wilkins:**

Yes, but I don't understand the mathematics of wave functions which do this. But can you say something more to try to make that?

**Bohm:**

You see, it's very hard to get an analogy. It's a kind of transformation that takes place. The nearest analogy would be that two rotations in different directions combine to form a rotation in a third direction.

**Wilkins:**

All right. What about a gyroscope then?

**Bohm:**

Well, no, that won't do. You see, you can't really.

**Wilkins:**

It's doesn't help. That moves in right angles to the direction you think it is going to move in.

**Bohm:**

Yes, but it isn't a very good analogy.

**Wilkins:**

It's not a good analogy.

**Bohm:**

No.

**Wilkins:**

So, you think that essentially there's no everyday?

**Bohm:**

Essentially, I was trying to produce in myself an analogy to that in my state of being, as it were.

**Wilkins:**

Something about your own mind/body relationships which could not be articulated very well.

**Bohm:**

Yes.

**Wilkins:**

I see. So, if it were possible to give a straightforward analogy like a bimetal strip or a gyroscope or something, then everyone would have done that.

**Bohm:**

Yes.

**Wilkins:**

That would have been the end of it. So nobody's got it, so that presumably that sort of analogy doesn't exist.

**Bohm:**

No.

**Wilkins:**

Oh, well. You would be able to write down the mathematics and this thing just comes out of the mathematics, is that it?

**Bohm:**

On the interpretation, you see. It isn't just the mathematics. That's where the problem is.

**Wilkins:**

The interpretation comes out of the mathematics.

**Bohm:**

No, it doesn't. It's assumed on top of the mathematics. That's the whole point of the quantum theory.

**Wilkins:**

This is a little bit beyond me. This is the end of the tape anyway.

**Bohm:**

I would put it that in a way, I am trying to become an analogy to that. Whatever that means, right?

**Wilkins:**

Forgetting all about you, how does the ordinary physicist, conventional physicist, thinking about this spin problem, think about it?

**Bohm:**

Well, essentially, I don't know how. I mean, Bohr has complementarity. He would say that the spin in the X direction and the spin in the Z are complementary if you define one, you undefine the other. The conditions needed to measure one will not —

**Wilkins:**

Yes, but how did he deal with the fact that you've got in the Z direction a plus and a minus and out of that you get something else.

**Bohm:**

He said that there's no way to imagine anything, that's the first thing Bohr say. You merely have a language which enables you to talk about it consistently.

**Wilkins:**

Okay. But look, the other thing is that you say that how does one arrive at a conclusion that the plus and the minus in a Z direction gives you something.

**Bohm:**

That's by using the interpretation of the mathematics. The idea is — I think last time we just got to the point of discussing the implications of the Hiroshima bomb.

**Wilkins:**

Oh yes.

**Bohm:**

I think we got a definition.

**Wilkins:**

Yes.

**Bohm:**

One point I wanted to add. You asked me what I felt about, whether I had some premonition of the real meaning of it, the danger in it and so on.

**Wilkins:**

The wider meaning.

**Bohm:**

Yes. I said, in general, not but because of various the reasons we gave. But [inaudible] called about a month or two after I'd had a dream, which I was walking in some sort of valley, which should have been in California. Although it wasn't exactly any valley I knew. On one side there was a very high ridge, a long high ridge, like a mountain. Not quite as big as a mountain. And on top of it were a lot of concrete buildings out of which a sort of cold, blue flames were emerging. It did not consume the building, you see.

**Wilkins:**

Which were consuming the building?

**Bohm:**

Were not consuming it.

**Wilkins:**

Not consuming the building.

**Bohm:**



Yes. It sort of suggested radioactivity to me. Then I saw that that was a ruined city as I was walking along. But the building resembled laboratories, you see. Concrete. They were sort of concrete with the cladding destroyed and the windows blown open or something. And out of it was coming the cold, blue fire. So, I must have had some premonition. If you think of the laboratory as representing science that the thing was the ruination of science, you see. That's my interpretation, at least the one I thought of.

**Wilkins:**

What was the feeling that you had about it?

**Bohm:**

Well, generally, sort of a very poor feeling, depression.

**Wilkins:**

You felt there was something rather bad.

**Bohm:**

It was very bad. There were ruins, you see. They were ruined. When I had been a child, my father

used to drive us around. We used to pass along the hill overlooking what they used to call concrete city, a whole bunch of concrete buildings that were never quite finished because they ran out of money or something. And it sort of had a very ruined, a rundown, ruined appearance. This was a similar feeling. While I was giving myself on the surface why nuclear energy would good and so on.

**Wilkins:**

You did on the whole feel very optimistic.

**Bohm:**

I felt it could be used. I remember Lawrence was extremely optimistic.

**Wilkins:**

Was he?

**Bohm:**

I thought there was no reason why it shouldn't be a very great benefit. I could see the dangers of nuclear war but there was still hope. Oppenheimer was still talking in terms of some sort of international agreement. The breakup with Russia hadn't fully

occurred yet and so on. I think that one could see that underneath the thing wasn't looking good.

**Wilkins:**

What wasn't looking good?

**Bohm:**

The whole thing wasn't looking all that good. That dream must have meant that.

**Wilkins:**

This feeling that you had, did you feel it was evil or not so strong as that?

**Bohm:**

Well, it was a kind of evil but it was ruined, it was destroyed. Something destroyed it.

**Wilkins:**

It was a negative feeling about the whole thing?

**Bohm:**

Very negative.

**Wilkins:**

A very negative feeling.

**Bohm:**

Yes. That all the possibilities in it were gone. It was just ruined, destroyed.

**Wilkins:**

I see.

**Bohm:**

The fire was an evil fire.

**Wilkins:**

Was evil?

**Bohm:**

Yes. The cold, blue fire.

**Wilkins:**

The implication was there had been a lot of positive possibilities in the whole thing represented by the idea of buildings.

**Bohm:**

Yes.

**Wilkins:**

But that all this was now destroyed.

**Bohm:**

Yes. And that this cold, blue fire, which evidently was radioactivity, destroyed it.

**Wilkins:**

Had taken over.

**Bohm:**

Yes.

**Wilkins:**

Like some sort of disease that killed it all off.  
Interesting.

**Bohm:**

So, probably there was the sense that it was really destroyed underneath. The meaning as I see it was the destruction of science and the destruction of all these possibilities.

**Wilkins:**

Positive things that might come out of science.

**Bohm:**

Yes.

**Wilkins:**

Let me just check. That's okay now, so I'll go on recording. I might mention, not a dream, but a conversation that we had in the Staff Club at Berkeley, which I don't whether I told you about around lunch. There were several scientists there and one of the American scientists was holding forth about how in the future all humanity would have to live under the ground in the Bay Area and so on. Everyone would be living in enormous sort of cavities under the earth to be safe from the nuclear war. And he seemed to find this quite exhilarating, working all the technical problems of this type of daily existence. And I was horrified at the idea you wouldn't be able to see the sky, and the clouds, and all the natural things on the surface. How could he be so insensitive? This always stuck with me very strongly. The attitude or the type of mental makeup

which some scientists have. They seem to revel in technical solutions to problems without any wider feelings for the whole thing.

**Bohm:**

No. They sort of narrowed themselves down. But I remember Lawrence was talking about how there would be very cheap energy, some tremendous advantages in terms of the United States becoming far more wealthy and so on. I can't remember the details. But you see, there were some people who felt that it was going to be a tremendous nuclear age and cheap electricity and unlimited power.

**Wilkins:**

Almost free electricity was sometimes spoken of.

**Bohm:**

Yes. After the War, what I did was I worked on these machines for a while. They went back to the peacetime construction of Cyclotron and so on. Serber [?] came there. The first thing was MacMillan [?] wanted to have some theory of the synchrocyclotron. First called the synchrotron, which was a fairly simple thing where there was a

certain property of phased stability. He wanted to look at the stability of orbits and so on. That was fairly straightforward. And then they had the synchrocyclotron, which was a little more complicated where it was for protons rather than electrons. They were a little worried. They had to inject these electrons into the orbit and they wanted to know if they would be captured. The reason there was a problem was that somebody at General Electric, working on an analog computer, had shown that it was not sustainable, that the orbits would have run away and not been captured. I was going back to visit Pennsylvania so they sent me back to visit General Electric in Schenectady. I looked at the machine and they had a lot of backlash in the machine. I could see right away it would grind along, and then turn around, and you could see maybe there was a backlash.

**Wilkins:**

It was a mechanical thing.

**Bohm:**

Yes. So I should by means of a simple argument that if there is backlash, then this will introduce



instability. So therefore I said there is no instability due to the machine, due to the computer.

**Wilkins:**

The fact that you could transmit mechanical backlash and divert it into electrical —

**Bohm:**

No, no. It was a matter that the machine would move along and have to turn around; there was a slight backlash as it turned around.

**Wilkins:**

You mean that you accounted for the existence of the instability —

**Bohm:**

Through the machine.

**Wilkins:**

— in terms of the mechanical backlash.

**Bohm:**

So therefore I told them not to worry about it.

**Wilkins:**

Yes, but that didn't prove that there couldn't be other instabilities.

**Bohm:**

Well, we proved as far as we were able to analyze it that they were stable. The trouble was here was this computer that says it's unstable, so what are you going to do? They sent me to Schenectady.

**Wilkins:**

But did the computer take into account the mechanical backlash?

**Bohm:**

No. Obviously they didn't know about it, you see. That's why they predicted instability. So I told them it would be stable which it was. We worked on problems like that for a while. And then I gave up the Radiation Lab and I went back for a half a year to work as a research associate with Oppenheimer where I mostly interested in superconductivity.

**Wilkins:**

Was that in Berkeley?

**Bohm:**

Yes. I made an intensive study of superconductivity but I didn't get very far with it. But one thing that I can remember about that time was that I was getting more contact with theoretical physicists. I was beginning to be disturbed that they all seemed to think equations were the truth and they were not really terribly interested in the physical understanding or intuition or anything of the kind. They'd say, "Okay. If you want to do it, do it but it's not really important. Don't bother us with it."

**Wilkins:**

To some extent, they may have thought that mathematics was a higher type of thought.

**Bohm:**

Yes, that was truth. The proper vehicle for truth or something.

**Wilkins:**

A sort of Pythagorean notion.

**Bohm:**

Yes. Others, I couldn't quite make out what they were thinking. I think others thought that all you really wanted to do was to find some way of calculating results and comparing with experiments, so why worry about all these other things.

**Wilkins:**

Just pragmatic.

**Bohm:**

And that really disturbed me a great deal. I couldn't talk it over with them because they would have said I was crazy, or "Why are you worried about it?" I remember thinking over and talking with a few people saying, "What can I do? Can I get out of physics?" This was intolerable.

**Wilkins:**

As strong as that?

**Bohm:**

Yes. But I couldn't think of anything else to do.

**Wilkins:**

Were there any other things you can remember considering?

**Bohm:**

No. Well, I thought of becoming an experimental physicist but then I said I didn't really want to do that. And then, I said that actually doing these calculations in this spirit is less interesting than being a businessman, at least you have contact with people. I said, "Why did I bother to go so far when I could have had something more interesting?" If all you're doing is calculations, mathematics — Well, I liked mathematics and so on, but just to do it in that spirit seemed hardly worth doing.

**Wilkins:**

You mean it was rather like just cranking a handle?

**Bohm:**

Some people would have said using problem solving, using your ingenuity to solve problems.

**Wilkins:**

Yes, there was ingenuity in it but on denying it, there was no real, what would you say, thinking?

**Bohm:**

Intuition or perception. As a matter of fact, I never really trusted these mathematical steps. I would always see ahead to what the answer was and then put the steps in which meant that the steps were often wrong, but the answer was right.

**Wilkins:**

Yes. Didn't someone say, or was it you who said, Fineman was like that. People couldn't understand him at first because he apparently always saw the answers before he had done the calculations.

**Bohm:**

Yes.

**Wilkins:**

So they thought he must be unsound.

**Bohm:**

Yes. See, there was a general feeling that going through these steps was the way to be really sure of things and have them be true and have the truth and

so on. And I didn't really believe it. I thought it was a rather unintelligent and ugly approach.

**Wilkins:**

You were really handing over the responsibility for the process to some kind of more or less automatic

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**Bohm:**

Yes. So, you were functioning as a computer.

**Wilkins:**

Yes.

**Bohm:**

Except when you had some ingenuity in solving a problem.

**Wilkins:**

I was thinking about this problem about repugnant for too much reliance on mathematics because I must say that all throughout my own career, I felt rather like this. I always felt slightly apologetic about it because I thought I wasn't any good at the mathematics and maybe I didn't recoil from the

math because I couldn't do it, kind of sour grapes attitude. But I remember I had a supervisor as an undergraduate at Cambridge, he worked on cosmic rays. I remember him once telling me, this was just one student, one research worker having a discussion one-hour a week. That was the system there. It was very good and so, you got to know a good research worker. And he once said, "When I read a scientific paper," he said, "When I come to the mathematics, I just skim over it, skip all that. And then I come to some words again and I read those words and I go on and read a few more. And then I try to sort of guess what all the mathematics means." That always stuck in my mind and I thought, "Well, that sounds sensible." But I think what you're saying goes further. It's made me realize, in a way, that my negative feelings towards people who were very agile in shooting out all these masses of paper covered with math, and being rather suspicious of the whole thing, that in a way this was probably quite a sensible approach then. I hadn't realized it.

**Bohm:**



I could see that people who didn't know what they were doing with these equations could say all sorts of stupid things.

**Wilkins:**

Yes. This was my feeling these people didn't know what they were doing. Yet they seemed always so damned cocky about it. They calculated all this as though there were some —

**Bohm:**

There are all sorts of assumptions in there. They treated it as if it were just plain truth once you put it as a formula; it's not an assumption anymore.

**Wilkins:**

Yes. I must say I always felt very suspicious. So in a way, presumably, then my sort of instincts were reasonably sensible. I never considered this enough. I thought it was just my lack of mathematical ability.

**Bohm:**

Yes. I think a lot of these people who are skilled at mathematics tend to look down on others and try to say that the highest form of thought is mathematics

and so on. And that the reason you're not doing it is you're not up to it and so on.

**Wilkins:**

I think basically I felt I probably was right but I still felt a bit apologetic about it.

**Bohm:**

A lot of mathematicians, people who are skilled at mathematics, are often very arrogant. I discovered that. In Princeton, they're very status conscious. You see, the people, the Institute, the math department, I was told by a few mathematicians, spent about half their spare time establishing the pecking order, talking about the pecking order. Who's the best, who's the second best, who's the third best.

**Wilkins:**

You mean the best mathematician?

**Bohm:**

Yes. Who's the one that's going to get the best job and so on. You see, there's an exceptional sense of pecking order among those mathematicians.

**Wilkins:**

So, there was a very clear notion of quality inherent in mathematics? Those who had the biggest amount of quality were the best mathematicians.

**Bohm:**

Yes. They were at the top of the pecking order. The others felt miserable as they got toward the bottom.

**Wilkins:**

So in a way, it was a little bit like the Pythagorean notion of virtue somehow of being in the numbers.

**Bohm:**

Yes. An ability to handle them and so on. Anyway all of this didn't attract me. I felt rather repulsed by it. I was really seriously thinking should I go in for biology or this or that. I didn't really want to change.

**Wilkins:**

Did you do any reading in biology at all?

**Bohm:**

No. I knew some people, you see. But I didn't really feel attracted at the moment.

**Wilkins:**

There weren't any particular biological problems you thought about at all? You hadn't read anything about Bohr and biology?

**Bohm:**

No.

**Wilkins:**

He never wrote anything, did he?

**Bohm:**

No. And I think I was just pestering my mind. I was really dissatisfied with physics and I couldn't quite see what to do instead. I probably came to the conclusion that I better stay in physics and try to find some way of getting on without some *modus vivendi*. I think the sort of approach I developed came up later in Princeton, perhaps. We'll discuss it as we get there.

**Wilkins:**

So this not liking physics was not in any way directly due to the explosion of the bomb. It might possibly have had some indirect connection but you weren't conscious of that.

**Bohm:**

No. It might have had some indirect affect.

**Wilkins:**

It must have been an unconscious, underlying thing that was affecting you. One doesn't know.

**Bohm:**

But the main thing I was aware of was that this problem, the mathematics.

**Wilkins:**

That seemed a good reason, anyway. Do you want sugar in the tea?

**Bohm:**

No sugar. I think that's nearly all I have to say about that period. As I said before, because of this paper I'd written on some of Dirac's ideas, it was really an abstract. Then Wheeler came to see me when he was

in Berkeley and he offered me a job at Princeton and I accepted it and I went there. I think it was January 1947.

**Wilkins:**

Was that a center for theoretical physics?

**Bohm:**

Right. I went to the university, you see.

**Wilkins:**

The University.

**Bohm:**

Princeton University, the Institute for Advanced Study. No. I learned at the same time that I went there that Oppenheimer was coming to be the head.

**Wilkins:**

Of the Advanced Studies?

**Bohm:**

That's right. I think he came a little after I did.

**Wilkins:**

But was the Advanced Studies largely theoretical?

**Bohm:**

Yes.

**Wilkins:**

It was theoretical stuff.

**Bohm:**

Yes. And so, I arrived in Princeton in January. At the beginning, I was there for a few months, not too happy because all I was doing was teaching undergraduate courses. There weren't a lot of people around yet. But I did what I could. The following year was better. It took a little while. Princeton was somewhat of a letdown from Berkeley. It was not quite as nice, not to me, anyway.

**Wilkins:**

You mean the physical surroundings and the climate.

**Bohm:**

That's right. Rather than worse, good. Although it's a nice town, but still it's flat and it's in this industrial area near Trenton. Although the area around

Princeton is quite rural. The only fellow who was there was a Japanese, the only theoretical man, a young theoretical physicist called Kwasaka [?], who was from Canada originally. He had been, had had some unpleasant experiences during the war. He had to leave the West Coast and go to Massachusetts to teach in some small school.

**Wilkins:**

What kind of unpleasant?

**Bohm:**

Well, he'd gone to Massachusetts and then apparently while he was there, a crowd of people gathered around his house and made all sorts of threatening —

**Wilkins:**

Japanese.

**Bohm:**

He was Japanese, yes. He was interned but he was allowed to teach there in Massachusetts.

**Wilkins:**



I see. It was just this wartime, anti-Japanese activity.

**Bohm:**

Yes. He was a difficult person. I went back to Berkeley during the summer and then I think we had agreed that he would, he found an apartment and we would share it.

**Wilkins:**

At Princeton?

**Bohm:**

Yes, in the town. While I was there in Berkeley, he went swimming on the Atlantic coast with some people and he apparently drowned. But I still had the apartment which I shared with somebody else.

Anyway, this first few months between January and June was a rather confused period, getting used to the place and so on. The following year, I began to teach, I insisted on teaching a graduate course along with the undergraduates. So, I taught quantum mechanics. I began then to try to teach the course in a way that a person would learn about it because I really wanted to understand the subject. Then I tried to teach it. I think it was an attempt to resolve this

problem of mathematics where I would try to weave together the physical, intuitive ideas and the mathematics. Sort of try to combine the two rather than focusing on one or the other.

**Wilkins:**

So having the teaching job then made you get to grips with trying to understand the subject.

**Bohm:**

The quantum mechanics. And also to approach this question of mathematics by saying it must be woven together with the physical idea intimately rather than seeing one or the other.

**Wilkins:**

Yes, but this was part of getting to grips.

**Bohm:**

Yes. I taught that course for several years, making notes on it for the class and gradually putting it into the shape of a book.

**Wilkins:**

This was your well-known book called what?

**Bohm:**

Quantum Theory. In that book, I tried to explain Bohr's idea and a lot of other physical ideas and also some new material, a new approach to the question of what was called the Paradox of Einstein. Rosen Poldovsky [?], which I don't know if we'll explain that a little.

**Wilkins:**

Was that the spins in different directions?

**Bohm:**

Yes. Well, originally it wasn't that. But I proposed to put it in a spin.

**Wilkins:**

You proposed to put it in a spin form?

**Bohm:**

Yes which in principle made it possible to test it.

**Wilkins:**

I see. But to what to extent was that book widely used? Was it widely used as a textbook?

**Bohm:**

Well, apparently it was after I left America for a number of years but I never revised it. It gradually fell out of date.

**Wilkins:**

Yes, quite. But what interests me is that it was apparently the approach to the subject was somewhat unorthodox.

**Bohm:**

Well, what does orthodox mean? I don't know.

**Wilkins:**

What I mean is that you had developed a certain amount of new approach to the subject and what surprises me a little bit is that the scientific community as a whole apparently were quite receptive to this.

**Bohm:**

Yes. Well, at least a great many were.

**Wilkins:**

Otherwise, they wouldn't have used it as a textbook.

**Bohm:**

It was used in quite a few places. Also, I sent the book to various physicists including Pavvy [?] and Deborwy [?] and Einstein and Bohr. I got a very enthusiastic answer from Pavvy who liked the way I was weaving the physics and the mathematics together and also raising philosophical questions. Bohr didn't answer; I don't know why. Some people told me later he had so much stuff coming on he never read it. Now, Einstein liked the book very much and wanted to discuss it with me. We'll come to that later. I got comments from other people but afterwards, it was adopted in a number of universities, a fair number. Some people didn't like it, they wanted more mathematics. But there's a fair number who did like it.

**Wilkins:**

But presumably, the physicists who weren't especially caught on mathematics probably welcomed it.

**Bohm:**

Yes.

**Wilkins:**

Because they could get a feel, they could get a grip on quantum mechanics without having to have too much mathematical facility.

**Bohm:**

Yes. There was one review which pointed out that I was weaving the physics and the mathematics together, which this fellow liked. In other words, not everybody in the physics community was happy about this emphasis on mathematics. There were a lot of people who felt pushed out.

**Wilkins:**

Yes. But I think presumably the point was that the people who were developing the theory of quantum mechanics tended to be in the main mathematical.

**Bohm:**

That's right.

**Wilkins:**

And so those people probably didn't like your book especially, but they weren't the majority in the physics departments.

**Bohm:**

No.

**Wilkins:**

So in a way, you were out of the stream and a bit unorthodox from the mainstream of mathematical physicists but you were doing something which quite a proportion of the not so mathematical physicists positively welcomed.

**Bohm:**

Yes. And this probably went back to my earlier wish to sort of present physics in a way that people around me would have understood, the ordinary people, you see.

**Wilkins:**

Now, just a minute. You haven't said very much about that.

**Bohm:**

That was as a child. To present it as close as possible to the common language. In a way, it was sort of answering some of my father's objections saying, "Oh, this scientism was way, way up in the air," you see.

**Wilkins:**

I see. I don't you think you spoke about this very much. Was this connected with the Amazing Stories and the Popular Science?

**Bohm:**

Not so much that but rather, you see, around the general attitude of both my father and people like him, and of the working people who were very down to earth. They would have thought this sort of stuff is so far up in the air that it couldn't have any significance.

**Wilkins:**

Too esoteric.

**Bohm:**

Yes. So the idea was to present it, I couldn't actually present in language they could understand, but as far



in that direction as possible. To make it close to the common sense language and so on.

**Wilkins:**

So presumably the motivation to communicate these latest developments in physics to ordinary people had two roots. Your father's reaction poo-pooing the whole thing.

**Bohm:**

Also other people of all sorts, both working class and middle class.

**Wilkins:**

But also presumably you felt some kind of general, political type of feeling about the need for communicating, educating the masses.

**Bohm:**

I felt that the culture should be, that science was part of the culture if I put in the language I now use. Everybody should be accessible to everybody.

**Wilkins:**

Yes. That the culture should be based in the common people.

**Bohm:**

Yes. At least it has to be accessible to it.

**Wilkins:**

Accessible to them. Yes. Even if it's not based in them at least accessible to them so they can, to some extent, participate.

**Bohm:**

Yes. I thought that was very important and some of these super esoteric people who didn't think that was of any importance.

**Wilkins:**

I think you found it repugnant the people who would extol the esoteric aspect of mathematics and in some way took a delight in having science so that it could not be accessible to ordinary people; it made them feel superior.

**Bohm:**

I felt I didn't want that at all.

**Wilkins:**

The common bond between all human beings and that science is part of culture, should be accessible to all people.

**Bohm:**

That's right. And the other point was, which I probably didn't formulate, was that I wanted say that to weave together the more esoteric with the more common, ordinary concepts.

**Wilkins:**

But that was a kind of internal attitude towards physics as such that you felt you ought to have a proper integration of mathematics with physics. There was, of course, at that time, if I may mention it, quite a lot of feeling amongst scientists about the need to make science accessible. In this country, you had a number of leading scientists, rather leftwing people like J. B. S. Haldane writing books. And he was even the editor of the Daily Worker in this country, the communist party's thing. I don't he spent much time editing but he officially was the editor. And he wrote excellent scientific stuff which

was intelligible to ordinary people. When I was an undergraduate, I was writing a certain amount of stuff for leftwing journals a little bit. A big feeling before the War but you're not speaking of after the War. But I think it still persisted. I think there was a big feeling amongst somewhat leftwing people that this new and very extraordinary developments in science should be made accessible, I think is probably the best term.

**Bohm:**

So anyway, the book was an attempt to make the ideas accessible to include philosophical discussion and extended it in certain directions, a new treatment of the question of measurement.

**Wilkins:**

Physics, mathematics, and philosophy if you want to make the division. Then all those three, especially, would have been emphasized. It didn't get political?

**Bohm:**

No.

**Wilkins:**

But politics were implicit.

**Bohm:**

Yes, it was implicit saying that culture should be accessible to everybody.

**Wilkins:**

Yes. Einstein, I think, went on record saying that he thought that any piece of science, however sort of esoteric, one could make the essential, a fair degree of feeling for the essential nature of the problem to any uneducated, intelligent person.

**Bohm:**

But the other point was from the side of physics to teach people to weave together these different ways of thinking rather than focusing on one.

**Wilkins:**

Yes. That was a matter for the professional scientist, but it was related to this wider question of culture.

**Bohm:**

It was sort of the idea that if you present it in a way which is more accessible you also have the advantage of a better way of thinking.

**Wilkins:**

So, really the whole idea of a scientist and politics have joined up, a unity between the whole thing there. Because to do good science you had to be doing it not good only from the point of view of the internal view of science but also from the point of view of the external relations of science, wasn't it? Interesting point that. Yes. It's good in two different senses that they're related.

**Bohm:**

It took me all my time there, three, say about four years to finish the book.

**Wilkins:**

Incidentally, if you can interrupt again in this connection, it's interesting that I've skimmed through a biography of Thomas Henry Huxley. His feeling apparently was that it was more or less a criterion of scientist truth that it had to be based in the, not necessarily based, but at least it had to have

proper connections and have some rooting in the common people. And that was one of the reasons he went up and gave scientific lectures at the Working Man's College in Camden Town. Now, that was, I suppose a bit after the middle of the nineteenth century. But the idea for a leading scientist to have the feeling that the science wouldn't make any sense somehow if it didn't have the social relation seemed to me a very interesting one. In some ways, I mean, that was a very enlightened view. But it's roughly equivalent to what you're saying.

**Bohm:**

That was really one of the things which occupied me during that time. I had several alliances. When I got there, I began with a few students. I had always been interested in the problem of the structure of elementary particles. If you say they're mere points, which is one of the waves theories I had been working, then you get these infinitives. Around each point there's an infinite field which gives rise to infinite properties like mass and other properties, which I worked on, as I told you last time, to renormalize the wave functions, to try to make them finite. But which was, in a way, an anticipation of

this renormalization theory although in a very simplified way. The idea I always had in mind was to say that these particles must have some small, extended structure which would get rid of the infinities. It was hard to make such a structure because of the Theory of Relativity which, you see, makes it impossible to define, to have any sense to any rigid structure. In other words, the Theory of Relativity requires every force to be transmitted at a speed not bigger than light. Therefore, you cannot assume a rigid structure which would turn force at an infinite speed. If you say the force is not rigid then you raise the same problem again which you were trying to avoid, namely the structure. If you say a rod or a particle extends out over a small distance but it can move every bit, it can move with waves inside. You have an infinite possibility of exciting internal motions which is essentially the same problem you had before outside an infinite number of field variables could be excited. So you haven't avoided the infinities that way.

**Wilkins:**

I see. It takes time for a disturbance to get from one side of the particle to the other.



## **Bohm:**

And that gives it an infinity of degrees of freedom, which is just what you were trying to avoid, which is the source of the problem in the first place. You've just put it in another place. In addition, it's very messy, extremely messy once you do that, far messier than anything you can imagine, and very hard to perceive. So, I kept on thinking up ideas of what we used to call finite distance interactions. That something would interact directly, over, across a certain region of space rather than having to depropagate it. The idea was that this would only hold for very short distances. But it was not possible to make it consistent. So you see, you could get rid of some of the infinities but then you discovered other infinities emerge somewhere else, or other inconsistencies. Like you would discover that charge was no longer conserved. It seemed you fixed up one thing here and something was wrong there. In other words, it was too simple an approach.

## **Wilkins:**

You were trying to reject what people call the almost mystical notion of action at a distance.

**Bohm:**

No, I was using it but finding that it led to these problems and therefore it wasn't clear where to go. I wanted to say there was an extended structure.

**Wilkins:**

Yes, but if you had the things in context and so on, then you didn't have action at a distance.

**Bohm:**

No, but then you had infinities. If you assumed that all action took place in contact it led to all sort of infinities, you see, which I was trying to avoid. By saying it's an extended structure but then if the extended structure was relativistic and internally mobile then it would have infinities of another kind. And on the other hand, if it were rigid and therefore a finite distance on local interaction at a distance then it led to still other kinds of infinities or other problems, such as non-conservation of charge. So it seemed you could fix it up in one way and you would just put the problems somewhere else. In other words, the whole approach was to restrict.

**Wilkins:**

You mean like sitting on a hot water bottle, you put it down one place...

**Bohm:**

Yes. But I spent quite a bit of time thinking of that. This notion of structure. I didn't greatly emphasize the idea of structure, the structure of the totality of the whole universe had a profound effect on me in spite of the fact that I'd been put off by these people who said you couldn't understand him. I told you about that.

**Wilkins:**

Couldn't understand what?

**Bohm:**

That nobody could understand him.

**Wilkins:**

Eddington?

**Bohm:**

Yes.

**Wilkins:**

You hadn't been completely put off by them?

**Bohm:**

The basic idea. I said it was truly you couldn't understand what he said when you looked into it but there were crucial points. But I felt there was something in the basic idea which he proposed, the spirit of it.

**Wilkins:**

Although he wasn't able to articulate in any clear way, you felt he still had something.

**Bohm:**

Yes. So I was very interested in the notion of structure. At the Institute for Advanced Study, Oppenheimer was organizing a group which was approaching this whole question in another way, which was to try to plummet it so it was independent of structure. It eventually came out as renormalization. To try to put it in such a way that your conclusions don't depend on any assumptions of structure. The spirit being, you don't know the structure that's tied to it, to draw conclusions that don't depend on structure. You see, the point particle

gave these infinities. Weisskopf [?] even before the War had already shown there were, in a rather straightforward way, he had shown that there are such infinities and so on. This was one of the problems what do to with them. After the War, this became one of the major, immediate problems confronting theoretical physics. Now, my approach was to say let's assume a finite structure. Well, it got into those difficulties that I explained. Now, the generally accepted approach was to avoid the question structure and to try to find a way of getting results which essentially monitors some system of subtracting off these infinities. I don't know when it was, probably 1948, there was a conference in the Pocono Mountains in Pennsylvania where all these physicists came, like Schringer and Weisskopf and Bohr and Oppenheimer. They were all there.

**Wilkins:**

A real big international meeting. Just everybody that mattered.

**Bohm:**

Yes. And Schringer came out with a very long talk that lasted about eight hours explaining his method

of removing infinities by, in a relativistic we call variant way. It was what he called manifest covariance. Essentially, he had a way of doing it. He had calculated a certain effect. If you take the interactions of the field and the particle then the particle is no longer moving, if you want to think, in the line it would move. But because the field is fluctuating quantum mechanically, the particle fluctuates a bit in its movement. And this changes the energy level slightly, very slightly, say hydrogen.

**Wilkins:**

Inside the atom?

**Bohm:**

Yes. And this shift of the energy level is calculated and compared with experiments. It was okay. There are various ways of calculating other effects of that nature. There are only a few of them done. By now, there are a large number which are verified. So it seemed that if there is a structure, the results of this nature are highly insensitive to that structure, so that there isn't showing up at this level, there is a deeper structure. But you see, Feynman got up and gave his

stuff. And Bohr got up and objected because he thought Feynman didn't understand quantum mechanics, but Feynman was talking about tracks and so on.

### **Wilkins:**

This was part of the whole thing about people feeling that Feynman didn't know what he was talking about.

### **Bohm:**

Yes. I think a year or two later, Feynman and Brandt talked together. Bohr agreed. At that time, Bohr felt that Feynman was just talking nonsense. It was only a couple of years later that when Dyson came along, a year or two later, Dyson came along and showed them mathematically equivalence of Schringer and Feynman. He was working at the Institute, Dyson. That was essentially the only thing he ever did in physics at that level anyway. And then from then on, everybody went on to Feynman because it was so much easier. That Schringer stuff was really difficult to calculate. To calculate an effect heaven knows how long it would take, 50, 60, 70 pages. Going that way, you see.

**Wilkins:**

You mean he was trying to run the whole of Los Alamos as well?

**Bohm:**

Yes. Also I found this concentration on mathematics very much. People didn't really want to think of these physical ideas very much. There was one or two people there who said, all these ideas, they liked them. Window dressing or frosting on the cake. You can have them, if you like, but the main point is the equations, you see. Also I could see that the math department was also even more arrogant in its way, constantly comparing with each other and establishing their pecking order. I suppose they had their pecking order in physics too but it was more subtle.

**Wilkins:**

It might have been more difficult to compare one experimental physicist with another.

**Bohm:**



They were theoretical. They were all theoretical physicists.

**Wilkins:**

Yes. What I mean is, if you're doing mathematical physics, it might be easier.

**Bohm:**

Especially if they're all working on the same thing. But the pressure was to work on this renormalization problem. I was interested in this extended structure that I explained and also in the plasma. Now, Oppenheimer never asked me about the plasma, he must have known I was doing it, so he wasn't interested. He must have thought I was an idiot to play around with this extended structure. I mean, he felt, you know, you should get on the bandwagon, and get in there, and get going, and get ahead and become a big shot or something.

**Wilkins:**

I suppose that fits in with Los Alamos. That was very much getting in on the bandwagon, wasn't it? Being a big shot.

**Bohm:**

Yes. Well also I think he was very much impressed. You see, I told you about this thing with Dirac last time, that he said, “Well, this problem I’ve been working on Dirac isn’t interested anymore, so it’s of no use.” You might as well give it up. The idea was that the value of a thing depended to some extent on the magnitude of the physicist who was doing it. At least you had to get tied up in that way with somebody. There was a sort of general feeling that only a few people were geniuses and could really do something original and the rest should do good solid work to back it up.

**Wilkins:**

Really a kind of snobbish.

**Bohm:**

Yes. It was also somewhat masochistic in the fact that most of these people would say they’re not geniuses. But it was sort of a kind of a prize. See, Weisskopf came up to me once and said, I can’t remember how it put it, but you should really get down to the, there were a few geniuses who do these

great things, you should get down to the ordinary stuff. He was trying to be helpful. He wasn't really being nasty.

**Wilkins:**

Well, I suppose this is a basic point because there are some scientists who are very ambitious to do big things. And yet, they haven't got the abilities and sometimes they need to accept what their limitations are. But I suppose the point is, who can ever say or who can ever know themselves what their limits are? I suppose that's the essential point, isn't it?

**Bohm:**

The other point was essentially to get down. I don't think he understood that my real objection was that these people were just turning out mathematical formulae. Essentially the idea was you should get on doing with what everybody else is doing and whether you regard that as the thing that's worth doing or not. For example, I was working on the plasma which couldn't be regarded as unduly ambitious. But they didn't even pay any attention to it. I found there were some more interesting points in there than what they were doing. I wasn't

necessarily trying to do something big, entirely, but rather I wanted to do something in a way which I thought would be interesting and worth doing.

**Wilkins:**

Does the word “meaning” come in.

**Bohm:**

Yes, it would have some meaning but to them it had meaning to turn out stuff. The meaning was that they would be on the bandwagon. Everybody would agree with it. The bandwagon would decide if it had meaning.

**Wilkins:**

It was a bit like belonging to a certain religious church or cult, wasn't it? That they were all in on the same thing and you had to confirm. The virtue was embodied in this particular cult.

**Bohm:**

They would have thought that plasma is not to do with it. In a way, they were ambitious too because they said they want to be working on fundamentals, which is these basic particles. So they said, “Plasma

doesn't interest us." But then they said, "Physical ideas don't interest us. The thing is to produce formulae so you can compare with experiments."

**Wilkins:**

They'd given up as a hopeless task trying to think in terms of physics.

**Bohm:**

Yes, in effect, they had. And so far as they said structure doesn't matter, all that was left was to try to find formulae.

**Wilkins:**

Do you mean to some extent Eddington, although he was very mathematical, was trying to have a feel for the physical aspects.

**Bohm:**

He was, yes. He had physical ideas in there, you see, in the mathematics. The thing like renormalization has very little physical ideas. It is a matter of adjusting. Not a great deal of good mathematics either because it's not mathematics in the sense of deducing consequences. But if you subtract infinity,

it's not mathematics. It's trying to find some procedure of changing the formula you've got so as to get a reasonable experimental result, reasonable predictions of experimental results. So, it's neither physics nor mathematics in a way, you could say. But it's becoming proficient at various methods of trying to get results. So, I felt that was really very dull. It was heavy and boring. I didn't see why I should do it. Again, I would have said, I think that Oppenheimer also regarded my work on the book as of no great value because as I told you before at some party he had said, when I finish this book, I should dig a deep hole and bury it.

**Wilkins:**

No, I don't think you said that.

**Bohm:**

I said that last time, I think. One of the times. You see, I wasn't there but somebody had been at the party.

**Wilkins:**

It wasn't in your presence?

**Bohm:**

No. Somebody heard it and they told me. So, you see I was rather hurt by that. But essentially he was trying to say, you know, for your own good, give this stuff up and get on with the stuff we're doing, which is what counts. Get on, make your contribution. He once made a talk at Princeton. Everybody brings his little brick to build up this structure of truth. So, this was not one of those bricks.

**Wilkins:**

Yes, but there was one boss on top to some extent who was designing the whole building.

**Bohm:**

Well, there were a few bosses. There were others on top of him. Von Neumann had said physics is organized, he was one of the leading people. He had said physics was organized like a church. He said, we've got a pope, and you've got cardinals, and bishops. I think he called himself, he said, I'm a cardinal.

**Wilkins:**

Who was the Pope?

**Bohm:**

I don't know. Bohr.

**Wilkins:**

He was being humble.

**Bohm:**

Yes.

**Wilkins:**

Didn't Von Neumann develop some really rather unpleasant sort of interests in getting ahead in the world in social attitudes.

**Bohm:**

I don't know anything about that.

**Wilkins:**

I think Vronofsky [?] said something about this. I'll look it up.

**Bohm:**



Yes. You might look it up. I had very little contact with Von Neumann, though he was at the Institute. His approach didn't interest me very much.

**Wilkins:**

Vronofsky was saying how he was so friendly and he little Von Neumann and he seemed to be saying that he developed in rather an undesirable directions that his work proceeded. I'll look it up and see what he says.

**Bohm:**

Yes. I don't know exactly. He went into computers and things.

**Wilkins:**

Yes. It was sort of commercial things. He seemed to be very much the opposite of your interest in making scientific knowledge accessible to ordinary people.

**Bohm:**

Yes. I would have felt at that time, you know, that if I had the qualities which enabled me Oppenheimer join the bandwagon and do what the majority were doing, then probably I would never have become a

physicist. I would have become a furniture man. I would have become a businessman and perhaps one of the leading furniture dealers in Wilkes-Barre.

**Wilkins:**

Returning to Von Neumann's thing, it really is ghastly. You mean that the idea of the church was that the priesthood were intermediaries who had special access to godliness and God.

**Bohm:**

Well, they would say, to truth, perhaps.

**Wilkins:**

But I think the whole thing was that you had this special privileged elite that was somehow handing, connecting ordinary people up to the higher truth.

**Bohm:**

Yes.

**Wilkins:**

That only through them it could be done.

**Bohm:**

The people further down really worshipped those above as Tolman [?] worshipped Oppenheimer.

**Wilkins:**

I see, it was in the attitudes.

**Bohm:**

Yes. And saying, “We are merely little people compared with them. We’ve just got to do our little thing.”

**Wilkins:**

How peculiar. So you mean, it was a real, conscious hierarchical system.

**Bohm:**

Yes, that’s right. And then they regarded that as virtue. The idea of trying to get out of that, they thought of as going beyond your station and really being not virtuous.

**Wilkins:**

It does seem to me that Von Neumann put his finger on it in this thing about, like a church, then didn’t he? How unpleasant. I suppose if you’re switched on

to Aristotle's idea of, what was it called, all the different levels, it's all very well. But I mean, it's funny to find this. I don't think this was quite around, I don't know, in the nineteenth century.

**Bohm:**

People used to sort of look up to Newton, I think.

**Wilkins:**

Yes. Scientists were looked up to but I don't know there was a structure in the scientific society itself. All the different levels all looking up to the one above. I mean, that's what's odd. Yes, scientists were the special elite, a superior being.

**Bohm:**

I think people were a bit afraid to talk freely, you know, if they saw their betters there and so on. In this Pocono Conference, the atmosphere wasn't free and easy. Even Schwinger, people objected, at first, to what he was saying. After a while they said, okay. We accept. But then they really thought Feynman was an upstart. They treated him that way.

**Wilkins:**

But I think you know that it's worth bringing this point out because how well known is this? You see, there is a lot of sociological study of the nature of science today. I mean, sociologists have been going at this a great deal and if from the inside picture you can bring this out clearly, it seems to cast quite a significant light on the whole sort of, what you might call, moral content of physical sciences at that time.

**Bohm:**

Is there more to be brought out?

**Wilkins:**

Well, I think that if what you've said and I think you have made it clear in what you've said but I think all the detail you've given, I think, every bit of detail you've given ought to be put in. About A regarded B as better than him. Well, I mean, was it like the army. Did B sort of kick around A down underneath him?

**Bohm:**

Well it was more polite than that.

**Wilkins:**

But did he treat him somewhat condescendingly?

**Bohm:**

At times, yes. You see, people at least felt constrained. They didn't feel free if B was below A, they didn't feel really free in the presence of A. Except that they tried to be more informal about it, to create an atmosphere as if it all weren't happening.

**Wilkins:**

Yes, but it was still sort of active under the surface. The surface idea that they played lip service to, to some extent was that you had an international community of scientists. There was a community of scholars in open debate.

**Bohm:**

It was all open.

**Wilkins:**

Yes. Whereas in practice, it was a highly hierarchical thing permeated by this slightly unconscious —

**Bohm:**

And they didn't want anybody to come up from below with new ideas. You see, they wanted him to sort of fit in. When he reached a suitable, or if he were an especial genius, that if he got classified as a genius, then they would say, it's okay. It's all right.

**Wilkins:**

You push him up quick. This happened in the Middle Ages. If you got a very bright boy in a cathedral school, then he could go up and end up as a bishop. There were always those sorts of safety values for the special people.

**Bohm:**

Yes. But in the beginning, such people tend to be treated as upstarts but then finally at some stage, they're recognized as geniuses and up they go and then it's all right.

**Wilkins:**

Yes. But the rigidity of the system had to have some in-built looseness. I think it's quite interesting. And what you say although in one sense it was like officers and men who couldn't properly exchange views socially.

**Bohm:**

They actually would eat together.

**Wilkins:**

Yes, they would eat together.

**Bohm:**

And talk about ordinary things together.

**Wilkins:**

Yes, but still sort of in spite of all this equality, there was this hidden element of the fairly rigid hierarchy. And you say that sometimes this became explicit in people actually stating that they looked up to somebody up there.

**Bohm:**

Yes. You should not try to rise above your station.



**Wilkins:**

Keep in your place.

**Bohm:**

Explicitly saying there are geniuses who belong up there.

**Wilkins:**

And you should know your place. But of course, if you can be sufficiently successful, then you may be recognized as a genius and elevated.

**Bohm:**

Yes. Elevated to the bishop or the cardinal.

**Wilkins:**

Like standing on a cloud, like Christ is risen or something, you'll go up to him.

**Bohm:**

Yes. So you see, Feynman was quickly elevated and everybody knew he was a bit odd but then they said, that's okay because he's a genius, you see. And his unusual methods can now be accepted.

**Wilkins:**

I think everything you said is very interesting. Because it sounds to me more clearly hierarchical than in many fields of society. You see, the whole picture that Europeans have is that the American science was essentially democratic and the hierarchical system or authoritarian thing was characteristic of Europe. One thinks of Germany or France.

**Bohm:**

But don't forget a lot of the scientists that came over from Germany, from France. That is most of the American theoretical physicists either came from Europe or had been trained in Europe.

**Wilkins:**

Yes. But on the other hand, you see, an Oppenheimer was an important element. He certainly, he was trained much in Europe. He was basically American, wasn't he?

**Bohm:**

Yes. In a way, my first impression of him was he wasn't hierarchical as I said, when I arrived at Berkeley. But that was compared with Cal Tech where it was obviously far worse.

**Wilkins:**

Which was very hierarchical.

**Bohm:**

Well, it was very rigid, you see.

**Wilkins:**

Cal Tech at least was really an American institution, wasn't it?

**Bohm:**

Yes, but I meant that one sensed a very rigid structure there. Now it seemed that Oppenheimer was open, was accessible, you see, to all the students. He talked on a more human basis. But compared with that, he seemed a tremendous improvement. But as you got to know him better, you could see that there was a more subtle hierarchy there nevertheless.

**Wilkins:**

Yes. And I think the other element is presumably related to this whole competitiveness spirit. Less competition meant you were going up the ladder.

**Bohm:**

Yes. And you see the Institute had a tremendous competitive spirit. That competition produced conformity because the only way to get up the ladder was to conform.

**Wilkins:**

Yes because you only were permitted to go up the ladder if you got approval from other people.

**Bohm:**

Therefore you had to work on ideas that were respectable. Unless you were so unusual, like Feynman, that you broke through. But that was the case in many, right?

**Wilkins:**

So, you were constantly seeking approval in order to be permitted to go up to the next rung.

**Bohm:**

Well most people would think, well, we're not going to go all the way up the ladder.

**Wilkins:**

Yes, their natural place as Aristotle might say. Find their natural level. God, I find this rather fascinating, this.

**Bohm:**

As I said, the mathematicians were just openly, constantly comparing themselves for the pecking order.

**Wilkins:**

Do you think things have got worse or better if you take the whole field of comparable areas of physics today?

**Bohm:**

Well, I should think that there, you know, it's very hard to make a comparison. You don't have the supreme geniuses that they looked up to. But at the

same time, you have a much more rigid institutional structure.

**Wilkins:**

Professionalization, careers.

**Bohm:**

Also the economic situation is harder thus the pressure to conform is far greater. At least those that didn't conform could find inferior jobs but now there are no jobs.

**Wilkins:**

Yes. So the whole thing is on rigidity of career structure and institutional structure now rather than the idea of levels of quality within the community of scientists. Yes, so it's changing that way. I certainly think you ought to bring this out because I think it will interest some people a lot because I think they have a sort of a vague idea of those early days before science was highly professionalized and institutionalized about the free world of scholarship and independent thought.

**Bohm:**

I had far more independence in the university because I never saw any of the theorists. I had very little in common with Wigner, I never saw him. Wheeler I talked to occasionally.

**Wilkins:**

Where was Wheeler?

**Bohm:**

At the Princeton University and so was Wigner. I was fairly independent probably on the basis of the book and research, I would've got ahead. I was an assistant professor. The next step would have been tenure.

**Wilkins:**

Your book had helped you career wise.

**Bohm:**

It would have but actually it didn't because it never had a chance to because it came out at the very end of this whole period.

**Wilkins:**

The McCarthy period.

**Bohm:**

Yes. And also the research on plasma would have helped me career wise enormously but again, it never had a chance to.

**Wilkins:**

Because of the McCarthy era.

**Bohm:**

Yes.

**Wilkins:**

Did the book help you financially?

**Bohm:**

When I left America, I made out the proceeds of the book to my mother who had separated from my father. And I know, she didn't actually use the money so I got it later. So, at least in the beginning, it was of no help financially either. The plasma work, there were two students I had, Gross and Pines.

**Wilkins:**



Were they working for Ph.D.'s?

**Bohm:**

Yes, that's right. There was a third, a Norwegian fellow. I can't seem to think of his name now. At the very end. Staver, Tor Staver. He got killed after I left America. He got killed skiing in Massachusetts. So, Pines wrote up his thesis. After I began to work on plasmas along with this extended structure of electrons, I continued my previous work on plasmas and applying them to gases. Trying to work it out more systematically the conditions for propagation and excitation of plasma waves and so on.

**Wilkins:**

I'm sorry. Isn't a plasma a kind of gas?

**Bohm:**

Yes. But later I applied it to the metal. I will explain all that. We began with gaseous plasmas which were the common plasmas. I had become interested in the conditions that exciting plasma waves and maintaining them and propagating them and getting a better physical picture of them and so on. See with Gross, we wrote several papers and he got his Ph.D.

on that. Then with Pines, we worked on another direction. I said the electrons in metal must be regarded as a plasma. There are free electrons and very high density neutralized by the positive charge. Therefore we should look at that as a plasma. The plasma frequency is then very high because the density is very high. It gets up close to the optical region, I don't know. So, the idea was that we should discuss plasma oscillations and how the electrons can be excited and so on. How you can treat them quantum mechanically. But in addition, there was a puzzle in the metal. The electrons have long range Coulomb forces. The electrons scatter each other. Now, when they calculated the scattering due to these long range Coulomb forces, they found that it was enormously greater; the calculated scattering was far too much to fit any sort of experimental values of resistance and so on. So, I had the idea that the plasma neutralizes every potential so that the plasma must neutralize the Coulomb potential of each electron in a short distance called a Debye radius. This idea had already been proposed by Debye for the electrons in an electrolyte. He said every ion is surrounded by a cloud of opposite charge which neutralizes it in a short radius. So, I

said that must be true in the metal too. Now, therefore it gets neutralized and that explains why the scattering of electrons on electrons is much less than the theory seemed to predict.

**Wilkins:**

It's got nothing to do with the fact that the ions cannot move in the metal.

**Bohm:**

No, no. It's due to the electrons moving. When it was necessary to work that out quantum mechanically and dynamically, to work out the theory of plasma, a theory in which simultaneously you got plasma oscillations on one side and the dynamic variables developed a certain number of collective variables as if they were a field of oscillations. And what was left were the individual particle variables which were screened. So the whole system sort of divided in two parts, individual and collective with the next connection between them. There was the possibility of exciting these plasma oscillations and this was verified later by somebody who passed electrons through thin films of metal and excited them. But see, there was a loss of energy at

this point, there was loss of energy according to the plasma frequency.

**Wilkins:**

Does it amount then, roughly, that although the electrons could move about very freely in the metal, yet they still were constrained in certain ways to be associated with the ions.

**Bohm:**

But not the ions, the electrons with each other. They not only screened the ions, they screened each other.

**Wilkins:**

But didn't they only screen each other by their relationship to the ions?

**Bohm:**

No. By the relationship to each other.

**Wilkins:**

I don't quite follow that.

**Bohm:**

Essentially, around each electron the other electrons as they move in random, they get pushed away a bit and they leave an excess of positive charge there.

**Wilkins:**

I see. So you have an electron-electron interaction which is somewhat equivalent to the way in which you get the screening of the field around a positive ion.

**Bohm:**

Yes.

**Wilkins:**

And then you've got the opposite sign. Yes, I think I vaguely see what you mean.

**Bohm:**

Yes. It's screened but it has to be done in a very dynamic way because then the electrons are moving so fast.

**Wilkins:**

Well, you have to have the positive ions in the metal, but that's not what this thing's about.

**Bohm:**

Yes. Essentially, I used the mathematics that Schwinger had proposed for the renormalization and using that and making a canonical transformation. We worked out how to handle the whole thing. In a sense, it was a kind of renormalization applied to the plasma but it led to new phenomena such as oscillation and screening and so on.

**Wilkins:**

Mind you, when you hear me say, “I see,” of course I don’t see this at all clearly. But I see that you’re linking up ideas from one type of thing with another which I think is probably sufficient from the point of view of general reader. If they get the vague feeling for what’s going on in the one kind of thing, you can then say, well, this was somehow equivalent in this other area of work. So you have the general and the particular, the individual and the whole again.

**Bohm:**

Yes. I could combine that with the book and with something also coming out later. The third point was following the interpretation of quantum theory. After

I had written the book and I began to question the interpretation of quantum theory—

**Wilkins:**

After you had written the book?

**Bohm:**

Yes. Because I began to think, I had written it from Bohr's point of view, what I regarded as Bohr's point of view anyway. But then I began to be a bit dissatisfied afterward.

**Wilkins:**

Presumably if you hadn't written it from Bohr's point of view, it might not have been so acceptable.

**Bohm:**

No, it might not. At least, I said it was Bohr's point of view.

**Wilkins:**

At least people might have the impression that it was Bohr's point of view.

**Bohm:**

Yes.

**Wilkins:**

In that sense it was fairly orthodox.

**Bohm:**

Philosophically. Except that I went into much more of the physics and physical ideas and philosophy. Most books would put about a page and they would get on with the formula.

**Wilkins:**

But as we said, many experimental physicists would probably be extremely grateful to you to have done that. But they couldn't stand the mathematicians either.

**Bohm:**

I will discuss that later because most of that came out about the time when I had this trouble with McCarthyism and so on. So I think with all of those things together it could have gone ahead in a career. Because Pines who worked with me became quite well known on the basis of that work and went on.



When I visited him in Illinois they seemed to look at him almost with awe.

**Wilkins:**

You feel that you were all set up, in effect, for an extremely successful career.

**Bohm:**

When I got back, Pines said that was the case.

**Wilkins:**

I think you have to accept their opinion. It sounds to me what you said seems to make a very reasonable case. If your work was setting up other people very well, it would all fit together. But you mean having to leave the country and go to Brazil, you weren't on the American academic scene and so you weren't available for going up the ladder, were you?

**Bohm:**

No.

**Wilkins:**

You'd been turned out of the monastery so to speak. In fact, you say that you're a case of political victimization.

**Bohm:**

Well, yes, except that I'm not sure that it is. You see, I mean, I have not gained more than I lost.

**Wilkins:**

Like being turned out of Princeton.

**Bohm:**

Yes. Because when I did go back and visited some of these places, including Illinois where Pines was teaching, I went through some of the classrooms, there was nobody there, they were graduate classrooms. And they were just boards all around the room just covered with equations. And I said if I had stayed there, that is what I would have had to do. In other words, it would not have been very interesting. I don't think I could have stood it, actually.

**Wilkins:**

You might have found yourself being absorbed into the ladder race of the scientific, physics community

and so you might have found it more difficult to do your own thing.

**Bohm:**

Yes. As a result of going to Brazil and Israel at the time, there were so few people around that I was really quite free. And also, later getting back to Bristol back where there were so few people, again, I was free.

**Wilkins:**

How long were you in Bristol?

**Bohm:**

For three years and a half. Maybe four. 1957 to 1961. Four years, I'd say.

**Wilkins:**

I'm just thinking about the time. We've done most of this, nearly all this other side. I wonder if we might possibly, if it might be a natural place to stop.



## Interview Session - 4

**Wilkins:**

Where did you go to last?

**Bohm:**

Sometimes I don't remember. We were discussing what I was doing in Princeton, you see. I was engaged at first of all in various work. I was writing the book on quantum theory and I set it up and Oppenheim felt this was a waste of time because he thought I should be working on stuff that was going on in the institute and re-normalization — subtracting infinities and something of that nature. I was working on an idea about trying to deal with these infinities by thinking of what were called finite distance operators and thinking of a structure of something having an elementary particle, having a finite size, and I worked on that for a number of years. I didn't really get too far. And then the third point was I was working on was the plasma with two students, one Gross and the other Pines. We worked out the classical theory of plasma with Gross. That continued the work I'd been doing in Berkeley. Pines extended this to the quantum theory — the

theory of metals — and we directed it towards some paradoxes that had been in the theory of metals or some problems. People had been trying to compute the resistivity of metals by considering how electrons are scattered in metals, and not only are the electrons scattered from ions and from sound waves, but also by each other. If you computed the scattering cross section of electrons from each other, you will get an extremely large scattering cross section because of the long range of the Coulomb force, and it looked as if it would be almost impossible for the electrons to move freely. By treating the electrons as a plasma, we showed that there were collective oscillations that are quantized and we said that there must be such oscillations, and it turned out to have quite a high frequency, you could work it out, somewhere near the optical region. Then one could show that because of this collective behavior, each electron repelled all the other electrons around there, producing what we call a screening cloud. The positive ions would screen that electron so that the actual range of the potential effectively was not very great, therefore you could understand that all this prediction of tremendous electron scattering was wrong.

**Wilkins:**

Really, the point was that some special higher organization, so to speak, was being built up inside the plasma.

**Bohm:**

Yes, but it also effected the individual particle's interest and the more organized it became; the free became the individual particles. Whereas, previously, the individual particles would have messed up with each other without that organization.

**Wilkins:**

It's an interesting example of high levels of organization sort of emerging out of something, isn't it?

**Bohm:**

Yes, it was a matter we discussed at Berkeley. It would have been very interesting to me, forming the idea of the collective behavior and the individual behavior and their interrelationships. These things were tested later. The plasma oscillations were found by passing high-energy electrons through thin films

of metal and looking at their energy losses and you could find there were quantized energy losses.

Various other features of this, which I cannot remember now, were checked by experiment a day or two later. We were also working out the energy of a solid and working out the energy, methlectrical [?] energy, these things must be taken into account. That was the sort of work that we were doing. There was a Norwegian student that came named, called Tor Stave. I had to leave Princeton before he could finish, but he actually got killed in a skiing accident, but David Pines finished and got his thesis out.

Those were the main lines of work. The third line of work was work on the interpretation of the quantum theory. I had been very interested in the meaning of the quantum theory from the beginning with Berkeley and starting from Bohr's view and I wrote this book which I had hoped to be from Bohr's view trying to understand it. Actually, it turned out that it probably was not all that close to Bohr's view. But I tried to understand it as best I could. I taught the thing for three years and put out notes and then finally a book.



**Wilkins:**

You were using it in your teaching?

**Bohm:**

That is right. I taught the graduate course in Quantum Mechanics 3. That is how I wrote the book. It was necessary, because otherwise I couldn't have found out what was clear, you see. One of the points about quantum theory was to say there was no underlying explanation for it. It was part of Bohr's view that there was no way to understand any process by which things moved or things happened at the quantum level. His principle of complementarity stated that there was a limit to how far you could apply classical concepts, but that no further concepts were available. What he said was that quantum mechanics was just a generalization of classical mechanics in the following sense that you begin with classical physics and you apply what you might call the classical algorithm — that's, Newton's laws — to compute things. You replace this with the quantum algorithm from Schroedinger's equation, but you apply it to the same concepts, and you can do this by saying that

the concepts are non-ambiguously defined in quantum mechanics in a complementary way between position and momentum. That means that he says the phenomenon is one whole and not analyzable. Therefore, you only deal with the phenomenon, and he says whether there is a reality or not, he does not mention further reality behind the phenomenon. He might believe there is or not. There's evidence from his quotations either way. But essentially it was a kind of positivist position by saying you could only deal with the phenomenon and apply the algorithm to the phenomenon to calculate the probabilities of various results.

**Wilkins:**

But in what sense was it positive? You mean?

**Bohm:**

Positivism.

**Wilkins:**

Was it from the sense that you could only — is that the point?

**Bohm:**

Yes, you could only do that. To say that it would not discuss any reality beyond the phenomenon. That is the essence of positivism, to say that science consists of nothing but correlation of the phenomenon organized logically or mathematically, whatever way you like.

**Wilkins:**

That's the only possible meaning that can be —

**Bohm:**

Yes, to say the phenomenon are all that have any meaning. And see Mach [?], for example, got very disturbed when Boltzmann thought the atoms might exist. He felt that it was unjustified, that they were metaphysical fictions. There have been two attitudes in science. One is to say that the concepts in some way corresponded to reality, and the other is to say that there is nothing but the phenomenon in their correlation.

**Wilkins:**

Incidentally, about this thing about the atoms — are they still — What about the chemists? Surely the chemists had some feeling that atoms are real.

**Bohm:**

A lot of them had, but you see the positivists came along to sort of criticize that and say they were talking metaphysical nonsense since they had never been seen, that they were just convenient constructs of the logic or something.

**Wilkins:**

I can see it was easier for the physicists to take that view and the whole of chemistry was a question of atomic relationships, isn't it?

**Bohm:**

There is two attitudes we can call the realists and the positivists. Positivism gradually began to gain ground in the late 19th and early 20th Century. For a little while even Einstein had a positivist approach, but later he said that was only heuristic. He didn't really believe it, you see. But, the fact that he used it

gave positivism a tremendous impetus, you see, because he never made it clear that he didn't really believe it. At least if he did make it clear, it was already much too late by the time he made it clear. It was many years later.

### **Wilkins:**

This relates to the whole business of scientists in general sort of doing something when creating the impression that they are doing something when they don't really.

### **Bohm:**

Then along came Heisenberg, who was an extreme and very strong positivist. He said that we should emphasize the observation and then the mathematics helps to compute the observation. But, he was not really a positivist because he was somewhat of a Pythagorean and a Platonist. He said that the mathematics expresses the reality and matter must somehow obey mathematical relationships and that the physical concept no longer has any meaning. He said he can no longer think of orbits of electrons or of anything going on. In this he effected by Pauli and by Bohr because they discussed it a lot. There

was a general view developed saying that you could not form any physical concept of matter, you had only the mathematics. Now Pauli believed in the reality whereas it wasn't clear whether Bohr did, but Pauli said the reality was mystical in the sense you couldn't really say anything about it and that the observer participated in it. Whereas, Bohr was against mysticism. He said, "The observer is detached, but there is a unity only in the phenomenon itself of the observing apparatus in the electron, but the observer himself is pretty detached from the experiment." That's what Bohr said, which seems reasonable to say the observer has almost no effect on the experiment once he set it up. The experiment will have a strong effect on the electron, but the observer, if he looks or doesn't look, it doesn't effect...

### **Wilkins:**

In separating the observer's instrument from the observer...

### **Bohm:**

That seems quite reasonable in the sense that the observer looks at some part of the instrument that's

very little affected by his looking, say the photographic plate or something like that.

**Wilkins:**

You said very little, didn't you?

**Bohm:**

I mean it's not significantly affected. The whole point is to create something to look at which is not significantly affected to the photographic record or whatever. You don't look at the thing right in the middle of the process of what is happening where you might affect it. For example, you might keep something in the dark while it's actually working if it's light sensitive, and then it will produce a result that you will later take out and look at, a matter of electrical impulses displayed somewhere where you look. If you look at the display screen, the fact that you look has a very little effect.

**Wilkins:**

But, that means your position would be that Bohr was unjustified in taking this view of separating...

**Bohm:**

I think that you could say that if he would put it there is a fairly loose connection between the actual observer — The scientists have thus far worked in such a way to set up situations where there is a rather loose connection between the observer himself or the experimenter himself and his experiment when it's working.

**Wilkins:**

That does not mean that there is no connection.

**Bohm:**

Bohr didn't mean to say no connection, he meant a sufficiently loose one so that you could ignore it for most purposes. Pauli viewed a much tighter connection, and later so did Wigner, who said that the observer's mind would play a key role in making the quantum process take place.

**Wilkins:**

How does it do that?

**Bohm:**

I'd have to come to that to explain... It is a rather technical question. The problem of interpreting the



quantum theory was not very easy. Bohr, Heisenberg, and Pauli all have differences though they were the architects of the Copenhagen Interpretation. Bohr almost ignored the reality of what he was talking about and emphasized the phenomenon. Pauli said it's real, but the reality must be apprehended mystically by participation. He was a mystic. He studied Kepler and various other mystics and he was in contact with Jung. He was quite strongly mystically inclined. Heisenberg was about half-way between them. Heisenberg was inclined to think about orbits and then he said you can't define them, or he said the electron is a potentiality which can realize various possibilities of being wave-like or particle-like, and Bohr would not use that language. There were sort of subtle differences between those three, but they sort of ironed out the differences sufficiently, so that people have the impression there was a thing called the "Copenhagen Interpretation." Other people followed on and — see von Neuman developed another variation of this which was more mathematical and was not the kind adopted by most physicists, where people tended to think of the quantum state as really existing in itself. He later became dissatisfied with

that and developed a quantum logic to try to make it more objective. On the other hand, Wigner went the other way and he said, “The quantum state is made objective only by the act of looking at it.” If there is a quantum process and it has one possibility or another, after Schrodinger’s equation, only covers all the possibilities and doesn’t tell how it manages to be one or the other. They say the wave function collapses. The quantum state collapses, which does not make sense because the word “state” is intended to be something that stands, but what is supposed to stand suddenly collapses. The point is in order to explain that Wigner proposed that when somebody actually looks, the collapse is explained, you see it as the result of looking. Schrodinger emphasized this problem with his cat paradox. He said, “Imagine a cat in a box with a gun pointed at it and mechanism to fire the gun. Send in a single photon through a half silvered mirror, there is a probability of one-half that it will go straight through the other half reflected.” If it goes straight through, it will operate the gun, otherwise, nothing happens. According to the present quantum mechanics, when you are all finished, you will have a linear combination of a wave function of the dead cat and the live cat.

Schrodinger's equation is unable to tell you that it's in a state of being either dead or alive. So, how does it manage to get one or the other? Wigner said that when the observer looks, then that's determined. This creates some paradoxes because you could put in there a conscious observer. Let's say he was not killed, but scratched or something, and he would know. Somebody would set up a wave function and not be able to say, but then they say somebody inside would still know. There are all sorts of things which are unsatisfying about the interpretation of quantum mechanics, and other people said that two universes will arise, one with a dead cat and one with the live cat. The point is that it was not clear. Bohr said the whole question is meaningless and there is no point in even raising it. There is nothing but a phenomenon and this is just an algorithm for giving you the probability of the phenomenon. There is no use trying to give meaning to the terms in the algorithm any more than you would give meaning to the power series by which you calculate that number. There really was subtle disagreement about the meaning of the theory though everybody could use it to compute.

**Wilkins:**

I think I got one point wrong when discussing Bohr in that thing I wrote, that I said that he saw an observer and observed as one and therefore this had obvious ethical implications, but he never said this.

**Bohm:**

He didn't think it was so for the physics. He may have thought it might be so in a more general sense.

**Wilkins:**

But, I think the thing is that I was wrong in saying that he was saying the observer and the observed are one, because he didn't say that.

**Bohm:**

It's the observing apparatus.

**Wilkins:**

That's quite different because there is not an ethical — there isn't a choice in the observing apparatus.

**Bohm:**

You are closer to Pauli there than Bohr.

**Wilkins:**

I really got that wrong. I'm a bit puzzled as to why Bohr, with his obviously great interest in social responsibility, made this connection when the point is because I got it wrong anyway.

**Bohm:**

The point is that one can see now by hindsight that there was a great deal of confusion and difference in the meaning of the theory. Of course, it wasn't at all clear then and, when I finished the book, I wasn't quite satisfied that I really understood it. But, I did send copies to Bohr, Pauli, De Broglie, and to Einstein, and a few other scientists. Bohr never answered and I was told that he got so much mail that he probably didn't look at it.

**Wilkins:**

I'm assuming he didn't know what to say.

**Bohm:**

Yes, he didn't know what to say. Pauli answered very enthusiastically and De Broglie wrote me saying he — No, I didn't send this one to De

Broglie. Einstein telephoned because I was staying at a house with some friends of his and he wanted to see me.

**Wilkins:**

He was at Princeton, too?

**Bohm:**

Yes, he lived in Princeton. I went to see him and we discussed the book. He thought that I had done as well as you could for explaining this theory, but he still was not satisfied that it was adequate. Basically, his objections were that the theory was conceptually incomplete, that this wave function was not a complete description of the reality and there was more to it than that. That was his basic objection. Determinism was a secondary point because he was ready to accept a statistical theory, if necessary, although he preferred a determinant. We discussed it and he felt that one needs a theory in which one could discuss some reality which was existing and would stand by itself and did not always have to be referred to an observer and so on. He really felt quite definite that the quantum theory was not doing this. Therefore, though he accepted that it was giving the

right results and would give statistically the right results, he felt that it was incomplete.

**Wilkins:**

Incidentally, have you kept Pauli's letter?

**Bohm:**

I don't think I have. Things got lost traveling around in Brazil. I then began to look at it again and I was saying, "Can I make another way of looking at it?" In other words, it seemed that Einstein was right and I already felt dissatisfied, that somehow people were turning a method of calculation into an explanation of reality. They wanted to say that their method of calculation corresponded to reality. It was part of the current positivist approach. Part of this positivist approach is to say that people believe something when it's an equation, and once you have an equation they believe then that the equation must be describing reality and they don't want to admit. They didn't want to say, "Well, this is a nice equation, it gives good answers, but it's not necessarily a description or a close description of reality." They wanted to say that reality is what corresponds to our equations. In fact, one of the

assumptions made was that the wave function gives a complete description of reality as far as this could be done. This is what Einstein objected to. I began to wonder does it give a complete description of reality? First of all, I thought of a scattering problem. Let's say a light has scattered off an atom. You'll have a wave coming along that scattered to form an outgoing wave and it gets weaker and weaker. Yet, you find that a photon is absorbed by an atom at one spot. There is no explanation at all as to why that happens in the quantum theory. It is merely a calculus for computing its probability. I asked, "Maybe it doesn't really give the whole picture, it's just a probability calculation." And therefore I then imagined another wave, an incoming wave, that was coming in that would then go into the atom and be absorbed. I postulated some connection as yet unknown between the outgoing wave and the incoming wave. The outgoing wave would stir up an incoming wave. That would in turn give rise to an outgoing wave which might stir up an incoming wave and you would get a whole process. Therefore, the photon could be scattered all along, moving along in some sort of rough track and it would exist



on itself in that way without always being thought of as something which is measured.

**Wilkins:**

What happens about the time, if the incoming thing and the outgoing thing — how are they related in time?

**Bohm:**

One is later than the other, clearly. The outgoing wave comes along and it stirs up an incoming wave. It turned out later, many years later, that I got a model which does just that, which came from the second approach that I had. That was the first picture that I thought of. I said that maybe the quantum picture of reality was incomplete. They only talked about the outgoing wave and ignore the incoming wave and the further outgoing wave. In other words, if they took one little bit of the process and said “that’s all” and because their mathematics only covered that, they said, “Reality must be whatever our mathematics covers and our mathematics covers this — that must be a whole reality.” They just automatically ignored the rest. That is typical of the positivist approach to say whatever we can see and

account for mathematically is all that we care about and all that we can...

**Wilkins:**

All that there is.

**Bohm:**

All that there is and all that's worth talking about, which immediately closes your mind off to anything else. That was one of my objections to positivism. I felt that positivism was a very harmful and destructive way of thinking. But, then I got a second idea. I had this idea already, before talking with Einstein, but Einstein said that he would favor some sort of deterministic theory. I began to think, "Could we explain this thing deterministically?" The first idea did not do so. It merely said there would be an outgoing wave which would statistically stir up some kind of incoming wave. I looked at the quantum mechanics as an approximation after Schroedinger's equation called the WKB Approximation that holds in the classical limit. In getting that equation you finally find a meaning in a so called Hamilton and Jacobi Equation, which represents the trajectory of a particle normal to a

wave with a certain probability distribution. That gave a model to say that we have got a wave, a particle moves normal to the wave and it has a probability distribution across the front of the wave. That is the classical limit. Suppose we look at this equation and don't neglect the things that led to the WKB Approximation, and I found this was equivalent to adding a new potential that depended on the wave function, which I now call the "quantum potential." I said, "That new potential, they would have to explain all the new properties of matter." I have the model, the particle goes normal to the wave with the probability distribution, but there is a new potential which has been ignored. In the classical limit, it's very small and therefore we expect classical physics hold. But, now in the atom it's going to have a very big effect. I worked that out in the one body problem and I found that it did work out quite consistently. I wrote a paper on that and I sent a copy to Einstein, Pauli, and to De Broglie and a few others. Pauli answered me right away, very angry and disturbed, saying, "This is nonsense and that this was old and not even new nonsense." It was old nonsense that De Broglie had done in 1927. They'd had the Solvay Congress there and that he

had demolished De Broglie there. He said, “The particle that was being guided.” De Broglie had proposed a theory in which the particle was guided by the wave and they had made fun of it by calling it the “Kindergarten Theory,” that the particle was like a little child who had to be guided. I got a letter from De Broglie saying that he had proposed this theory already. I then went to talk to Einstein and he said, “Okay, it’s alright,” but he didn’t like it because it seemed it did not go deep enough. He said this quantum potential; it’s just an assumption and has strange properties and so on. He wanted a theory that would have explained the thing more deeply. Meanwhile, I worked out the answer. Pauli had made an objection to De Broglie which sort of really knocked him out, because when they did the two body system, it turned out that this model involved some very strange behavior connecting distant particles. De Broglie had never answered that very well and he finally gave it up. So, I worked out an answer. I worked out this model for the N-body system. It had new properties and non-local potential and all sorts of new properties, this quantum potential. I show that, actually, it could have answered Pauli quite well. I worked out a theory of

measurements and I showed that it gave the same results as the usual theory, but it gave an explanation for everything. I published that in the Physical Review later. After I got to Brazil it was published. That was the sort of work I was doing there. I had to leave America before I could find out the reaction to this paper because it was only published after I left. I had become more interested in philosophy gradually all the time. I became interested in causality and the objective existence of things and all sorts of questions like that. It seemed a large part of my interest in physics was in those questions. Even if you go back to Berkeley, when I felt very unhappy about physics. People only wanted equations and didn't want concepts of any kind. I remember that I told you that I had been thinking of leaving physics and I couldn't quite see anywhere else to go. That was about the status of my work in Princeton.

**Wilkins:**

Where did this work which you published while you were in Brazil — did this develop later?

**Bohm:**

Yes, we did some more in Brazil and more, later. I'll have to go into the history of that as I go along. It did develop. I sent the thing to the Physical Review just before I left America and it got published about a year later, while I was in Brazil.

**Wilkins:**

[???] didn't object to it?

**Bohm:**

I learned later that it was their policy that they did not object to it, but the leading physicists, like Pauli and Heisenberg sort of put it around that there was nothing to it. It was considered nonsense. People generally took their cues from the leading physicists.

**Wilkins:**

This was not a question of rationality. It was a question of some kind of feeling that authorities are right, because they are authority.

**Bohm:**

Because they are more capable.

**Wilkins:**

There is some element of rationality in it. You are just having a trust or a faith in the ability of these people to be right without understanding why.

**Bohm:**

Of course, all these events were to some extent overshadowed by the difficulty with the Un-American Activities Committee. I don't know how much we discussed before, but if you remember, I was subpoenaed by the Un-American Activities Committee several years before I left America, probably about 1948 or 1949, and refused to testify on the basis of self-incrimination. At first it seemed this was going to die down, but then came the Korean War and a very bad atmosphere. It began to build up again. I think in the summer of 1949, I was subpoenaed to appear before a grand jury in New York and I did not testify.

**Wilkins:**

You just remained silent?

**Bohm:**

I said on the basis of self-incrimination.

**Wilkins:**

Is that all you said?

**Bohm:**

Yes. They were saying, “Well, we are not a committee and we are a really serious body and you can and should testify,” but I didn’t. During that autumn, probably about November, suddenly I came to my office and somebody came in and said that he was a U.S. Marshall and was arresting me because of contempt of Congress. I said, “What are we going to do?” He said, “We’ll go to Trenton and get bail.” And, then I said, “How much is the bail?” He said, “\$20,000.00.” That was a lot of money in those days. I said, “It can’t be. I have known other people who have been indicted for this and their bail was around \$1,000.00 or so.” I was wondering what they had against me. I called up my lawyer who did not mind. He allowed me to do that. The lawyer said he would look into it and was sure it was a mistake. We went to Trenton and waited there in the courthouse



with the U.S. Attorney until finally he got a call from Washington saying the bail was \$1,500.00, which I wrote a check for. The fellow then drove me back to Princeton. We talked about various things, Einstein and things like that. He seemed interested a bit in science. He was a Hungarian and he said that he had become an American which was very important to him and he was very loyal to America and was hoping that I was not doing anything disloyal. He was quite friendly, actually.

**Wilkins:**

What was the year when the Rosenbergs were executed?

**Bohm:**

That was after I left, I think.

**Wilkins:**

After you left? I see.

**Bohm:**

I am not sure, but I don't recall them being [???

**Wilkins:**

Things were still sort of in a way, getting worse after you left?

**Bohm:**

Yes.

**Wilkins:**

Incidentally, there is one thing in all this. To what extent did the aspect of being a Jew come into the McCarthy?

**Bohm:**

I don't think he emphasized that very much. At least I am not aware of it. He even had a Jewish attorney working for him. At least if not him — I think it was him.

**Wilkins:**

I certainly had not heard it, but on the other hand, if I can just jump back for a minute so I don't forget about this, presumably one of the reasons your family had left Europe — of course and I put it. To what extent did the discrimination against Jews, as

well as the economic difficulties, to what extent was this a factor in making [inaudible]?

**Bohm:**

I think it was more economic. My father was in a very bad economic situation as his mother and father had died in the plaque and so on. The Jews there in that village of Muncacha [?], which was really a city, some of them were really well off and others were very poor.

**Wilkins:**

Your family did not come from an area where there were pogroms and?

**Bohm:**

No. I think Hungary was really more civilized in those days. It was the Austro-Hungarian empire, though there was anti-Semitism, it didn't take a violent form. The same was in Germany, which was more orderly. They would not have allowed riots like that. More in Poland and Russia was where that sort of thing happened.

**Wilkins:**

It varied quite a bit, you mean, the extent to which people were driven out by economic difficulties or by racial difficulties. Sorry to interrupt there, but it suddenly came into my mind that we haven't discussed this. You got your bail then?

**Bohm:**

Yes. Then I got a letter from the college the next day saying that I was suspended from the university, on pay because I was under a contract and that I wasn't supposed to go to the university at all.

**Wilkins:**

Did you say unpaid?

**Bohm:**

Paid.

**Wilkins:**

Suspended with pay.

**Bohm:**

They had to do that because I was under a contract. I remember somebody from the student paper came to interview me and we talked a bit and he said, "What

are you going to do?” And, I said, “I don’t know yet. I have no idea.” I was sort of waiting. You know in November a number of people had been indicted. They had wanted to challenge this self-incrimination method.

**Wilkins:**

The argument was that, if you said something that you might incriminate yourself, even if you were not guilty.

**Bohm:**

The argument was that since the general subject was Communism and that was regarded as a crime, you might incriminate yourself if you were especially — If you once said you were not a member of the Communist Party, then you were free of that and therefore you had to talk.

**Wilkins:**

After that, you had to talk?

**Bohm:**

Because they say there is no crime from there on. You only incriminate somebody else. If you say that

you had never been a member of the Communist Party, for example, then they would say that you cannot use self-incrimination because the inquiry is into Communism.

**Wilkins:**

The position you take is that I may be guilty, but I am not going to claim that you have no evidence...

**Bohm:**

You may be asking me about other people, but it may turn out that I, too, was a member and I would be incriminating myself. This line of questioning might lead me to incriminate myself.

**Wilkins:**

The whole idea of the self-incrimination thing is based on the notion that you may be guilty, but they can't do anything about it if they have no evidence.

**Bohm:**

That's right. They can't do anything about it. In any case, they weren't doing anything about their membership anyway, at that stage, but it could be

used. The idea was that it was in principle it could be used. I think they wanted...

**Wilkins:**

That was a good piece of human rights that remained, wasn't it?

**Bohm:**

The Communist Party was legal, but in view of a lot of the laws that had been passed about its activities, you could make the argument that in effect it was criminal. So, you argued that way. I think the government tried to argue that it wasn't really a crime to be a member of the Communist Party.

**Wilkins:**

The government?

**Bohm:**

Yes. Therefore, you wouldn't be able to use self-incrimination. They said, "Look, it's perfectly legal." The other argument was that though it may be illegal. Some of the other things that have been attached to it that it's effectively illegal. So many other questions have come in, right?

**Wilkins:**

The point is that if you simply refuse to give evidence, which means you are just being...

**Bohm:**

That is called Contempt of Congress.

**Wilkins:**

Right, and that's — you have to have some good reason for refusing to give evidence and, this idea that you might incriminate yourself by giving evidence is a justification for saying nothing. That was a good piece of human rights that remained, wasn't it?

**Bohm:**

The government was challenging that. They were carrying the case to the Supreme Court. I remember sometime during that winter that somebody's case arrived at the Supreme Court and the court ruled that it was all right, that you could use this self-incrimination right. As soon as they did that, I realized that it applied to my case, too, but we still have to go through the trial, which was set for June.



**Wilkins:**

What time of the year was this?

**Bohm:**

It was winter. November was when I was arrested. Probably by January or February I heard this new decision.

**Wilkins:**

Yes, it was pretty long business.

**Bohm:**

I remember going into the institute and hearing about — people were talking about it or I heard it on the radio or something.

**Wilkins:**

About your name?

**Bohm:**

No, about the new decision.

**Wilkins:**

The new decision. The date they knew what your position was?

**Bohm:**

No, the people that I heard talking about it didn't know. They didn't know me. During that winter, I couldn't go to the university. I found that I was doing a lot more work and was able to work far more effectively, not only because I had more time, but because I found that there had been a very subtle repression or oppression going on in the university environment in the sense in that, though nobody asked you to do anything in particular, there is a kind of pressure all the time to think in a certain way, just merely in order to talk to people inside.

**Wilkins:**

To fit into the group.

**Bohm:**

Therefore, your mind was limited. In a way, this thing made it much easier for me to develop this new interpretation and to go deeper into plasma work. I

made much more rapid progress during that time than at any time before.

**Wilkins:**

But, you wouldn't have made that progress unless you had lots of opportunity for contact with physicists earlier.

**Bohm:**

Yes. Primarily, with the students and the library and some of the few physicists. I didn't have a lot of contact with most of them. Most of the contacts didn't help me very much.

**Wilkins:**

I mean, over your career as a whole.

**Bohm:**

Yes.

**Wilkins:**

I think really the thing about making progress is a matter of having a lot of contact and being able to be free of that contact at certain times. I mean, it was the same with Einstein. He had to steep himself in

all the physics before him, didn't he? Before you get free of it, so to speak. I suppose he had to know what he was getting free from.

**Bohm:**

I did all that and then in June came the trial. I remember staying with the Condon's that year. They invited me.

**Wilkins:**

Condon? You mean Condon at — was it Berkeley?

**Bohm:**

He was now at Washington. He was in the Bureau of Standards.

**Wilkins:**

Nice man.

**Bohm:**

That night I stayed there. Then there was the trial the next morning and I went with my lawyer and we had to wait while various cases were disposed of, all sorts of cases, some people stealing checks and one person for murder. When my case came, my lawyer

said he had a talk with the prosecuting attorney and they talked about some of my scientific ideas and so on. He seemed interested. But the prosecuting attorney still tried to trick me. He referred to one place where it seemed — I can't remember the details in the testimony to the Committee. Somehow, they had asked me a question which they thought they had me on, you see. I had made an answer and the lawyer put it out.

**Wilkins:**

Incidentally, about the Condons, could you say a little bit more about why the Condons — you mean you were living in their home.

**Bohm:**

No, for one night. Each time we went to the Un-American Activities Committee they invited me and also my friend, Ross Lomanitz.

**Wilkins:**

Was this in a different town?

**Bohm:**

In Washington.

**Wilkins:**

You had to travel to Washington from Princeton.

**Bohm:**

Yes.

**Wilkins:**

You needed somewhere to stay for the night and they put you up.

**Bohm:**

Yes.

**Wilkins:**

Were they generally supportive?

**Bohm:**

Yes.

**Wilkins:**

So, Condon was very much opposed to this whole [???] process.

**Bohm:**

Yes, in fact, he himself had defied the Committee in some way. I can't remember the details, but it was a way that they — He had opposed the Committee quite strongly.

**Wilkins:**

Incidentally, about Oliphant, apparently there was something in a newspaper about trying to blacken Oliphant's reputation and saying that he had given information to the Russians. It's interesting the way these things — almost no limit to it.

**Bohm:**

They weren't accusing me of giving information. What they really wanted was for me to testify, so it would build up a case against somebody else and presumably, eventually it might get you...

**Wilkins:**

But, there was, apparently, some intelligence report about some Australian who was claimed to have given information. But, the whole thing was very confused and apparently, this newspaper thing about

the Australian being Oliphant and what he had done was quite — no justification for it at all. It just shows the sort of thing that goes on. In some countries, one can take legal action about things like that. Incidentally, I found that Eric Burrup was doing magnetron work in Australia, so Oliphant had a connection through the radar work with Burrup before Burrup came onto the Manhattan Project. However, back to your story.

**Bohm:**

I was acquitted. I then began to think about what I shall do.

**Wilkins:**

That meant that whole case against you fell completely through.

**Bohm:**

Yes, but it was part of the whole structure. All these cases had fallen flat.

**Wilkins:**

They might come to life again, you mean.



**Bohm:**

They couldn't now because the Supreme Court had ruled that you could —

**Wilkins:**

You thought you were completely safe?

**Bohm:**

I was safe from that, not from everything. I knew that the whole environment was very poor and also I couldn't get a job. In other words, I found out Princeton then was not — I could back to the university, but my contract was going to run out at the end of June and they were not going to renew it.

**Wilkins:**

Because of the fact that you were being tried or accused.

**Bohm:**

No, because I had refused to testify, basically.

**Wilkins:**

I see. Because of your refusing to testify, you were on a black list and you wouldn't get jobs in many places.

**Bohm:**

Yes. I assumed that was the case and I went to several people, to H. D. Smythe [?], who had been head of the Atomic Energy Commission, had formerly been head of the physics department at Princeton. I went to Oppenheimer and I went to Einstein and I can't remember who else. I said, "What shall I do?" None of them were very optimistic. Smythe said that he would try to get me a job somewhere. He said maybe Louisville, Kentucky. I didn't really want that, but he found that he couldn't even get me a job in Louisville, Kentucky.

**Wilkins:**

This was an undesirable place to...

**Bohm:**

It was really way off in the sticks. So, he was convinced that I wouldn't get a job anywhere. Oppenheimer was quite convinced. Einstein, I was told later, asked Oppenheimer if I could be his assistant, but Oppenheimer said it would embarrass him too much. That I can understand because he knew what was coming for him. There was going to be an attack on him coming. It wouldn't have helped me to be in that position.

**Wilkins:**

Incidentally, did you notice the thing in that Oppenheimer book about him and his having offended the Admiral and how the Admiral was out to get him, quite apart from the politics, just on personal antipathy? I think it was a nice thing that Einstein put up this idea of your working with him, don't you think?

**Bohm:**

What happened was that I knew some people in Brazil. They had been students at Princeton, graduate students, two people, Tiamno [?] and

Shutzer [?], and I wrote letters to them. They suggested that I might get a job as a professor at the University of Sao Paolo. They approached the head of their department who approached the Rector and they approached — They knew there was going to be trouble because of all that I had, so they said that I should get letters supporting me.

**Wilkins:**

From Americans?

**Bohm:**

From Americans. I got a letter from Oppenheimer, for which he got into trouble later, and I got a letter from Einstein and from some others. With those letters they made application. It was sent to the governor of the state and to various other people. Then I was offered the job in Brazil.

**Wilkins:**

How long was the job for?

**Bohm:**

Three years. But, it was expected that you would be able to continue. It is contracted every three years.

**Wilkins:**

Sort of a permanent job?

**Bohm:**

If I had taken their concorso — the competition — In order to get a permanent professorship there, they have what they call a concorso, a competition you have to go through and the one who wins it gets the — Usually, if somebody has been holding the chair for a while, it's rather a formality. In other words, it could have been turned into a permanent job. Then the problem was to get a passport. I applied to the State Department and I wasn't getting anywhere. I went to Oppenheimer again and he suggested writing to somebody in the State Department, which I did. I went to Smythe and told him about my problem and he said that he would see what he could do. Incidentally, when they said that they wouldn't renew my contract, almost the entire physics department went to the President to try get it renewed, but he wouldn't do it. The only one who didn't go, apparently, was Wigner.

**Wilkins:**

Why do you think that was?

**Bohm:**

Two reasons: One is he is very much against Communism and, secondly, his way of thinking was very mathematical and mine was not. He didn't really want the department to develop along those lines.

**Wilkins:**

He wasn't sympathetic scientifically and he wasn't sympathetic politically.

**Bohm:**

I applied for the passport and I hoped that these people would do something. I went to Boston to visit one of my students. I think I got a telephone call while I was there saying that finally the passport had arrived, to my surprise. I rushed back and began to get ready to go to Brazil. I remember I was preparing to go to Brazil and I was walking on the streets at Princeton and I met Oppenheimer and he said, "Haven't you gone yet?" He was sort of

implying “don’t delay.” Early in October I got to Brazil.

**Wilkins:**

What year was that?

**Bohm:**

1951.

**Wilkins:**

How did you find it in Brazil?

**Bohm:**

That is a long story, of course. Is there anything more we should discuss about Princeton?

**Wilkins:**

I do think this point about being cut off from the stimulating effect of your colleagues is an interesting paradoxical point which...

**Bohm:**

One or two other points I can remember that I wanted to discuss. Do you want to say anymore?

**Wilkins:**

No.

**Bohm:**

Of course, a great deal was going on in my mind in connection with thinking about philosophy and about politics. At that time I still felt that Socialism might be the answer. I didn't have much hope for what was going on in America at that time. It looked as if things were getting pretty grim. Not merely politically, but I also felt uneasy about the whole way things were going. If I can put it, the way where people are put in the papers as a kind of very superficial materialistic orientation to life. I remember seeing people in a small cafe, young people listening to the jukebox and it seemed very superficial. I remember crossing the river toward New York and seeing a tremendous pile of masonry and I felt uneasy about the way that was all going. I was wondering if this movement to Brazil would be kind of an adventure to open up into a new — I was hoping that maybe their people would be a bit more old fashioned and would not have got caught up in this yet.



**Wilkins:**

You mean you might find them in an earlier stage of development, which was more positive.

**Bohm:**

Yes.

**Wilkins:**

The Americans in the United States had already passed their peak and were down a bit.

**Bohm:**

Yes. That is what I felt. I said that maybe in Brazil — all the rest of the world will catch up in it, too. But meanwhile, it might be nice to go into something where it's not caught up.

**Wilkins:**

A new sort of frontier.

**Bohm:**

In a way I was looking forward to going to Brazil because I didn't like this whole atmosphere, and not merely the political atmosphere, but a lot of the rest

of the atmosphere. It was tied up also with the attitude to science and so on. At that time, I had been slowly building up the view that science might be important in transforming the consciousness of people into a more rational and forward-looking way. At that time, I thought of a plot for a science fiction story, which shows the way I was thinking. This plot began with some beings from a very distant star who had been civilized for millions of years, unimaginably advanced in every way. The whole conflict had disappeared between them. They could sort of get together in a group and talk. One would talk and the other would be an instant contact. There was sort of no fear of anything at all. They really had left all that behind over the millions of years of civilization. The idea was that civilization had transformed these beings from primitive violent beings into this sort of thing. Some of them were traveling in a ship and passing Earth, picking up indications that there might be trouble there and probably nuclear particles. Therefore, they came down to investigate. They settled down somewhere near someplace. People all around were wondering what in the world was this. They looked and they got more and more nervous about it. They waited days

and days and finally they began to attack it with all their weapons, but they could get nowhere. Finally, somebody dropped an atomic bomb on it and nothing happened. Finally, they gave up. After a sufficient time, the beings came out and established contact with humanity. After going through a long story, it turned out that they wanted to help humanity. They would give them all sorts of science and technology. They wanted all the nations to unite all over the world. After a long period of negotiations, the nations did do it. They got together and they began to set up a group in order to absorb the science and technology. An international group with many scientists drawn from all over the world. As they proceeded, some of the scientists began to see tremendous power in this technology and the idea dawned on them that they could become the lords of the universe and humanity. So, they got into touch with their governments and began a plot to use this for that purpose.

### **Wilkins:**

This was new science brought by these nice people?

## **Bohm:**

Yes, new science and new technology. As they were going on, they began to recruit more and more scientists into their plan. They were recruiting a particular scientist and they said, “Why don’t you join us?” He went home to think about it. But suddenly it occurred to him, he got an insight into this new science, that it involved and applied such unity in everything and that there was no point to such a plot. At first, he may have thought maybe he would do it. When he came back and told them he didn’t want to join, they became worried about him. They said, “He knows about the plot and he is not one of us,” so they killed him. But, at that moment, a being passed by and saw it, so they had to kill him, too. Then everyone began to get very frightened and said, “What are the beings going to do?” It had become known that they had killed a being and a panic spread all over the world. Will they annihilate us? Will they obliterate us? The beings did nothing for three days and people got more and more worried. There was a real panic all over the world. Meanwhile, on the side of the beings another thing was going on. This was the first time in millions of years that one of them had ever been murdered. This

was such a shock that they went crazy. It stirred up all sorts of primitive things that they thought had been gone for millions of years. They were afraid they would just go to pieces then and there. Finally, they worked it through and got over it. They came out and proposed — Now the whole atmosphere in the world was different. They were anxious to do anything to placate the beings. They set up a world government and a new system and all sorts of things and got it going. Finally, after sufficient time, they left, the idea being that both sides had learned something in this encounter. One of the points of this story is that if you saw the infinite unity in things and the infinitely deep unity in things, there would be no point to this sort of strife and conflict between people that's been going on all the time. That was the idea.

### **Wilkins:**

But also, weren't you saying that it's the essence of science is this unity and therefore, it makes sense in all this de-unifying, aggressive behavior is contrary to the essential spirit of science?

**Bohm:**

Yes, and of humanity. I was sort of implying that science was also the essential spirit of all intelligent life.

**Wilkins:**

Yes, an expression of it. Science is simply one form. The process of doing science is one expression of the sort of creative principles of life. This is the argument you can use that scientists shouldn't be doing weapons research, for example, because it's basically unscientific.

**Bohm:**

Yes.

**Wilkins:**

This is precisely the sort of argument which doesn't seem to interest scientists at all, I find, and which I find very well peculiar.

**Bohm:**

It's because of this long conditioning that has been going on for this long period of the Cold War, partly. That's added to it a great deal.

**Wilkins:**

I don't mean ordinary scientists, scientists who are dedicated to nuclear disarmament and God knows what in working for peace as they call it, in the peace movement. These people don't seem interested in nuclear disarmament.

**Bohm:**

I think they become cynical. The point is that all this experience with science used destructively has made many people cynical. In the '50s, the atomic bomb was fairly new and even then they were a bit cynical, but it has gotten a lot worse.

**Wilkins:**

What is interesting is to find the idealistic scientists who are working for peace and have a hope that science can be used to establish peace. But, even that minority of scientists has got this switched off and

cynical, and they have become blind to the essential unifying nature of science.

**Bohm:**

I think they become petty is a better — You see, they distrust us. I remember talking, not exactly about this, but something related saying that there is a creative intelligence, which is really essentially the same point. This comes out in science. I talked to somebody and I was very idealistic and inclined toward the left in the peace movement and so on. He says, “It sounds like delusions of grandeur.” So, my answer to him was that most people have delusions of pettiness and they make themselves very small.

**Wilkins:**

I think that puts it well. I think that one of the reasons is that people are frightened by 19th Century delusions of grandeur and the arrogance of scientists in the 19th Century. They are frightened of that. As a result of that fear, they go to the other extreme and say, “Oh, no,” and try and play down this special quality of what is present in science, because they are — It’s an irrationality really, to swing from the — They are afraid of being arrogant.



**Bohm:**

Must be very petty.

**Wilkins:**

There's no project, really. I think that's certainly part of it. People are very much afraid to get up and say these grand things about science because they think that if they do they will then start getting puffed up into arrogant attitudes, as many scientists did in the 19th Century. I think that's part of it. I think that this is an important thing, but ultimately it seems to me that unless this sort of creative principle is recognized. Where, ultimately, are you to find a whole basis for wanting peace or anything else? What the hell do you want to get rid of the nuclear armaments for and have peace for if you can't recognize any creative principle? You might as well be dead. Peace without creative principle.

**Bohm:**

You might as well [??] for conquest or something. The point is that there were people, as you say, in the 19th Century, that had these various visions of grandeur and some people attached into the nation

and said our nation must be great and so on. Now that sort of dies out in all directions and it has good and bad effects. I think that people have a very petty view of what a human being is and the view of what a human being is helps to make him what he is.

**Wilkins:**

Science has been telling [???] human beings are nothing but [???], nothing but that.

**Bohm:**

In a way, that's arrogance to say that something is nothing, but this is an extreme — this pettiness is actually an extreme form of arrogance.

**Wilkins:**

That's a good point, to make ultimate pronouncements. Ultimate passing of judgment.

**Bohm:**

Yes, that everything is very small. Everybody being cynical and saying that everything is nothing and that everybody is very small.

**Wilkins:**

Yes, it is passing judgment which is not [???] ultimately for human beings to do. Yes, anyway, your story, they both learn something out of the encounter. But I think, you see, presumably one of the difficulties about that sort of story is this: that you can give a picture of these very advanced beings who didn't have jealousies, didn't quarrel, didn't have misunderstandings and didn't do all this sort of thing. But, what you can't do is give anybody a clear picture of all the wonderful things they could do, because these are something essentially you can hardly visualize.

**Bohm:**

Yes, you can only give a vague notion of what they could do. The feeling I had was of some sort of almost perfect contact.

**Wilkins:**

Yes, I think that is something, but what do they do with the perfect contact? Presumably, you could then give descriptions and it would all be like a group of musicians playing together and all these types of

things. You would have to refer to already existing examples of cooperation and creativity.

**Bohm:**

To say that life itself would be like a kind of music, creatively booked in some way.

**Wilkins:**

But, by definition you can't carry it very much further because what you create is something which you cannot know.

**Bohm:**

That is why this story would be so hard to write.

**Wilkins:**

But I think you could still sort of dance around it quite a bit, as you say in talking about the whole of life as being like music and so on. An enormous sort of sense of joy and, oh, I don't know what you would say, all the beautiful color. I don't know what you'd see, you know what a good building?

**Bohm:**

The creative perceptions of new things and even just going into science is one of the things in a new way and some are a very different way.

**Wilkins:**

But you see the thing is, I think presumably what you'd say is that going into science is good in so far as it is a creative process. It is constantly leading you on to all these new sorts of prospects. Like a piece of music playing. Once you try to define things of any particular stage, you would go dead on it, wouldn't it?

**Bohm:**

The idea was that it wasn't going to do that. It was constantly in flow.

**Wilkins:**

All I'm saying is this that you can't sort of give a picture. It is like trying to define life itself, isn't it? That you can't define. Have you thought of writing this story?

**Bohm:**

No, I couldn't write it. I don't think anybody could write it. It would require some extraordinary writer of extraordinary imagination.

**Wilkins:**

You mean to somehow attempt to transcend some to these essential difficulties?

**Bohm:**

Yes.

**Wilkins:**

I agree that this is so, but presumably, good creative writers and so on, they have this special quality of being able to give little hints and nudges, and so on, which give you this vivid sort of feeling.

**Bohm:**

In science, some of the movies for example, like "Encounters of the Third Kind" and "ET," a little bit of that has been communicated. Very little, because

they didn't attempt to show the lives of these people, they showed a glimpse.

**Wilkins:**

If they tried to show more, it would have gone wrong.

**Bohm:**

Because they wouldn't be able to.

**Wilkins:**

I never saw that. It is an example of we're trying to be explicit, [??] kill it.

**Bohm:**

I felt that the dream, which was probably implicit in a lot of my attitude to science which was disappearing in the United States. They were getting caught up in all this, not only political stuff, but also this materialistic emphasis on results, money, position and power.

**Wilkins:**

This has been happening all over the world.

**Bohm:**

It was merely faster there. I had the hope that somehow in other parts it hadn't gone so far.

**Wilkins:**

What happened when you got to Brazil?

**Bohm:**

It's a complex story. In some ways that's true, it had not gone so far, but they had other difficulties. It wasn't all that good.

**Wilkins:**

Economic and political difficulties?

**Bohm:**

Yes, and general chaos of the society. That was the other side of the coin. I think maybe we should — there is no point, there is only a few minutes left. I think we should discuss Brazil separately.

**Wilkins:**

I remember visiting Brazil in 1951 because you were there. We met, didn't we?



**Bohm:**

Yes, it was a little later than 1951.

**Wilkins:**

But the interesting thing was that at that time, we were beginning DNA double helix work here. So, the whole molecular biology was very exciting, as the possibilities of great breakthroughs. Wherein, you in physics saw the physics as rather, not turning in on itself, but getting somewhat arid. The biological things seemed to have great possibilities. The only question is to what extent are creative possibilities actually achieved? This is sort of another question, isn't it? One feels, to some extent, that the whole molecular biology thing, I feel, rather was sort of dead, sort of mechanistic of a gear wheels business. I think one saw it as a great creative challenge when you get these things, you receive them as being not as lively as they seemed at the time.

**Bohm:**

I think physics was going in for a slow period at that time. I don't know if I can think of anything else about what was going on then that's relevant to this.

**Wilkins:**

Did you have any interactions with other people that you discussed these problems with who had views about it?

**Bohm:**

A few. I was staying with somebody called, Eric Cullar [?], who was sort of a scholar in history. He wrote books. He was very interested in social questions.

**Wilkins:**

This was at Princeton?

**Bohm:**

Yes. They were the friends of Einstein, Eric and Lilly Cullar. Einstein used to come to their house, but by the time I got there, he was a bit too old to do

that. I talked with people, of course, that I knew, but I don't know if I could...

**Wilkins:**

But, were there any people that you had known for some time that you kept in touch with so you could sort of compare notes with the way in which the world was changing, all that kind of thing?

**Bohm:**

I kept in contact with various people, friends I see in Brazil. I had known Melba Phillips. She had been a student of Oppenheimer.

**Wilkins:**

Where was she?

**Bohm:**

She was in New York at Brooklyn College. I had friends among the physicists. I don't know if my acquaintances were all that broad. I wrote to various people after I got to Brazil.

**Wilkins:**

But on the whole, you were fairly paddling your own canoe, so far in the main. You were developing your own ideas pretty much on your own.

**Bohm:**

Yes, those were mostly my own ideas. In the case of plasma, I worked with the students who got their degrees.

**Wilkins:**

But, in general, that was more sort of working out the details. It was working things out. The general sort of planning of direction, development of sense of direction and so on, you were doing yourself.

**Bohm:**

Mostly. I talked with a few people. I think that I determined most of it by myself.

**Wilkins:**

How did you feel about doing these things on your own? Did you feel any degree of isolation, that there

weren't lots of other people around who seemed to be doing similar things?

**Bohm:**

You mean like the work on physics or things like that?

**Wilkins:**

Physics and philosophy, sort of overall sharing of interests.

**Bohm:**

I felt that there was a lack and there weren't too many people. I didn't feel it that keenly. I was sort of looking forward, hoping that somewhere in Brazil or maybe getting to Europe I might find more. That was a vague idea I had in mind.

**Wilkins:**

You had some thoughts about Europe then.

**Bohm:**

I thought that if I didn't like Brazil, I might go on to Europe. There were a few people I knew there in Princeton and I could talk some philosophy with

them, like Eric Cullar. But, on the whole, there wasn't a lot of opportunity. One could see that the physicists were not interested in it. So, I was dissatisfied, but it wasn't getting me down at the time. I felt that it was an important problem, but it wasn't the major question at the moment. I was hoping I would have new — I remember talking with someone and saying that — I can't remember what, but that there would perhaps be some people interested in philosophical questions there in Sao Paolo. I was sort of hoping that maybe because they were more old fashioned that there would be more of it.

**Wilkins:**

Yes, that's the sort of thing I said when I went to Malaysia, that some of the science and spirituality, I said, "They can't do this in the West, maybe you could do it here." In a way one's kidding oneself and kidding them. It's not wrong. I don't think it's being dishonest, but I think the chances of it happening is probably not very big.

**Bohm:**

You'll see when I discuss Brazil, that there were one or two down there who I could talk with. On the other hand, the whole atmosphere in Brazil was so difficult, the whole situation. It had some good points, but it was a very hard place to live. There was some sort of consciousness of deterioration going on in America. I remember when I was talking to Melba Phillips, it was sort of a joke, she said that America was the one country that went from barbarism to decadence without passing through an intermediate phase of civilization. It seemed that they hadn't had time to really allow this culture to develop before all these things started happening.

**Wilkins:**

This is part of the whole problem of rapid change. It is one aspect of it, isn't it, that there is no time for the more supple aspects of culture to come into being. That certainly was the sort of thing you see in places like Malaysia with the new industries and the skyscrapers and all the new advances going up that it's all so limited, economically and materially, that there is no sort of cultural development. To some

extent the United States has been — well, it's never been as bad as that. But it's a bit that way.

**Bohm:**

At times it has been. Essentially, it has developed some culture. But, I think this new atmosphere, this new attitude and this new situation developing in modern technology sort of ran away with things and before it could develop much culture. It is happening here, too. It is happening everywhere.

**Wilkins:**

Absolutely. I think the old cultural aspects which were good in Europe are being expunged gradually, aren't they?

**Bohm:**

Fundamentally, science and technology are going in the wrong direction. That science fiction story was pointing to what I thought was the right direction. I already felt that America was going in the wrong direction. I had this romantic notion that maybe elsewhere it hadn't gotten that far yet.



## **Wilkins:**

It is lack of courage, really, on the part of the scientists. You have to combine courage with clarity of thought, because the lack of clarity of thought in the 19th Century led people into stupid arrogances, but they had some going them then. It wasn't having some energy and go and so forth isn't enough because you have to be prepared to, certainly to learn from mistakes of the past if you want to go beyond that, too. You've got to sort of feel this essential quality of life embedded in creative activities. That, of course, is exactly what there isn't much of, presumably either in the arts or in the sciences anymore. It's not just the science, it's the whole, the whole of culture.

## **Bohm:**

We might discuss that later. It is sort of deteriorating. It was probably implicit all the time that it would do this, but in some way this technology has been the cause of the deterioration, this wrong development of technology.

**Wilkins:**

It turned human beings into machines, didn't it?

*Pure Mathematical Physics*

## Interview Session - 5

**Bohm:**

Let's see. Last time, we were more or less finishing Princeton. I thought I would add one more point and then go on to discuss Brazil. You see, remember what I was saying about this science fiction story and the attitude to science that suggested, which I think indicated the way I was thinking about science and the way I continued to think about it for at least 20 or more years after that. It would be fundamentally something that would transform human beings if they would see the full meaning of it, of that science fiction story. Do you remember?

**Wilkins:**

Can you remind me?

**Bohm:**

It was The Matter of the Beings.

**Wilkins:**

Yeah. But how did it transform you?

**Bohm:**

You see the scientist saw, when he was asked to enter the plot to dominate the universe, he began to think it over, and he saw the full implications of the knowledge they were getting, that there was such unity in everything, that there was no meaning to trying to dominate that only friendship and cooperation would have any meaning.

**Wilkins:**

You mean because friendship and cooperation is an expression of unity, make it a form of unity.

**Bohm:**

The wholeness. Yes. And that these people, these other beings had reached that stage a million years ago.

**Wilkins:**

Yes. I haven't quite got that. Yes. I see. I was saying the same thing. In this whole business of weapons research. I was saying the essence of science is sort of unity, which comes out in all sorts of different

ways, and therefore, the whole idea of fighting with other people is essentially?

**Bohm:**

Pointless.

**Wilkins:**

Yes. It's contrary to the essential spirit.

**Bohm:**

Not only the spirit of sense, but I was trying to say that this knowledge, when perceived deeply, would be contrary to the content of science as well as to its spirit.

**Wilkins:**

So it wouldn't work.

**Bohm:**

It wouldn't work, which obviously it doesn't. And that is?

**Wilkins:**

Beyond scientific, I think.

**Bohm:**

Well, contrary to the factual nature of things.

**Wilkins:**

So it would be unscientific to work in that way.

**Bohm:**

Yes. And that the result must be disaster, which in fact, it has been.

**Wilkins:**

Yes. So it's really unscientific to do weapons research.

**Bohm:**

Yes. Well, it's unscientific to have nationalities fighting each other and so on.

**Wilkins:**

That's part of weapons research.

**Bohm:**

Yes. So then after the whole thing, the whole nations were organized into a world government. But I

neglected to say that part of this was the infusion of this knowledge into all of mankind. In other words, in this very sensitive state the people got into when they were so terrified and didn't know what was going to happen, they were open for a moment to something new. At that very moment when the beings came out of their own insanity, remember, because they had been for millions of years never exposed to this, and they had it deep down in the unconscious, their violence. So therefore, the human race was exposed to this knowledge in the way this particular scientist had been, at a moment when they were really very ready to listen, and therefore, there was a widespread comprehension of the futility of all this conflict. So that this time when they set up an international organization, it worked because the people saw that there was no other way, whereas previously they sort of went through the motions, or else they stuck together merely in order to conquer the rest of the universe.

**Wilkins:**

And then once it was set up, it would remain?

**Bohm:**

It would remain as long as people could see this was the basis of reality. In the same sense people would say, we are not going to try to walk through the wall because that doesn't make any sense.

**Wilkins:**

You mean once they've got, so to speak, into the habit and learned to live in a certain way, they maintained it continually.

**Bohm:**

Also because they continue understanding that is the only way possible. Every other way is going to lead to destruction.

**Wilkins:**

It leaves open the thing as to whether they could be backsliding or not.

**Bohm:**

They might or might not, but at least that was the suggestion. And possibly they would be better. See, even the beings, after a million years?



**Wilkins:**

They were backsliding?

**Bohm:**

Certain circumstances made them backslide, so the human beings, doubtless, would have gone through many, many phases of backsliding, but with the hope that they somehow would get through it.

**Wilkins:**

It's a little bit like the idea of evolution, sort of once you've gone forward, and you're not going to step backwards again.

**Bohm:**

You may step back a little, but it's going to generally go forward. That was the idea.

**Wilkins:**

Pity you couldn't find some writer to talk about this with and try and get some? Do you know any science fiction writers?

**Bohm:**

No. I don't. You would have to have somebody with a very good imagination, that understands these beings, you see. Well, there was another point I wanted to bring up. A little bit before I had this idea of a science fiction story, also I had another dream which somehow seems related. It was?

**Wilkins:**

By the way, you don't think it can be made into a play?

**Bohm:**

Well, you would have to think of the plot and the dialogue, and what nature these beings would have.

**Wilkins:**

I wonder whether this playwright, Halliwell [?], that I know, would be? He seems to have a good mind.

**Bohm:**

Well, we'd have to really work on it intensively. You've got to make these beings plausible in this

society, but not really give the glimpse of them.  
You've got to sort of get an intimate look at them.

**Wilkins:**

Anyway, you say this dream? What was this dream?

**Bohm:**

I was staying in a certain house where they had a cat, and in this dream, I came into the kitchen, and I saw the cat talking to another cat, and making a date to meet at a certain time. I said, there must be something wrong here. I wonder what it is. So I thought about it for a while, and I said, oh yes. I know wrong. Cats can't tell time.

**Wilkins:**

Can't what?

**Bohm:**

A cat is not able to tell time. So I said, Okay. I understand what's wrong. So I said to the cat, "You cats are not able to tell time." The cat answered me back and said, Of course we can tell time. And I said, "Well, look at the clock. What time is it?" It was about three o'clock. It was him that hawed and

said, A quarter past eight, five past nine. So I said, there. That proves that cats can't tell time. And then I woke up laughing. See, the point of the dream was that we are concentrating on small inconsistencies in the whole situation. There's something fundamentally wrong staring us in the face that we are assuming, and just simply accepting.

**Wilkins:**

What do you mean? You were ignoring the important fact that cats can't talk.

**Bohm:**

Yes. That's right. I simply took it for granted that cats can talk. And I said, "That's very mysterious." How in the world can they tell time? They don't have the equipment for telling time. They never heard of time. So the meaning of the dream was that something similar must be happening in society, that people are arguing about small points, and their taking for granted some very obvious point that should be staring us in the face.

**Wilkins:**

Sort of not paying any attention to something important.

**Bohm:**

Yes. And sort of diverting ourselves by arguing about small points so that we won't see the main point.

**Wilkins:**

Yes. This whole thing, you may know that something is there, but if you pay no attention to it? It seems to me a peculiar state of affairs, but it happens in ordinary life a lot, doesn't it?

**Bohm:**

Yes.

**Wilkins:**

Very peculiar.

**Bohm:**

The mind doesn't want to pay attention to some very fundamental factor. It's obvious.

**Wilkins:**

But if you pay attention to anything, it means that there must be something that tends to set that attention in motion. So I don't think it's always a question of not wanting to, is it?

**Bohm:**

Well, if it's very obvious, then the question is why isn't it noticed? Things that you want to see, which are not obvious, you're able to notice.

**Wilkins:**

Yes. So sometimes I agree that there are blocks, and I suppose there are sometimes other things that you don't pay attention to. I don't know whether the block theory is quite enough, but anyway, I agree. So what kind of thing?

**Bohm:**

Well, it wasn't clear to me. The vague idea I had at the time was that there's something in society we're overlooking, and we're just arguing about all sorts of things like socialism, capitalism, this system, that system, and everything. Probably it was related to

this science fiction story in the sense it was the unity of everything that we're overlooking. Pretending that all of these people were separate, and all these nations are separate and arguing, "How in the world are we going to do something about it?" What should we do? Assuming that we have all these separate people and nations and races and social systems? What I had in mind is that we simply overlooked the evident unity of mankind, the oneness, and we're arguing about all these side issues, and having accepted division, and we say, "What are we going to do with it?"

**Wilkins:**

Do you think that some people have had a sense of this unity in the past?

**Bohm:**

Well, some people have, and many people haven't.

**Wilkins:**

For example, what kind of people?

**Bohm:**

Even ordinary people have it, and it's implicit in many religions, such as the Christian religion.

**Wilkins:**

So it's mainly religious people who have had the strongest feeling for this unity.

**Bohm:**

Some scientists have had it, I suppose in the past, and a few?

**Wilkins:**

Who, for example?

**Bohm:**

For example, I was very impressed once when I was in college, when I read about a whole bunch of scientists in World War I who were sort of in different nations that were fighting, but they simply continued to work together by some indirect correspondence somehow. They simply ignored this nationalism.



**Wilkins:**

I suppose that you might say Newton or Faraday, for example, might both be examples of somebody's strong sense of unity.

**Bohm:**

Right.

**Wilkins:**

And they both happen to be religious people, of course. Yes. So really?

**Bohm:**

Even the socialists had the dream of the unity of mankind, but they got caught up in accepting all of the divisions and that overcame their dream of unity.

**Wilkins:**

Yes. Presumably, the main sort of motivation or origin in socialism has been from the Sophists and the Protestants, Christians, and other origins like that, which had a philosophical religious basis?

## **Bohm:**

Or even the Catholic Church, the word Catholic means universal, and they take it seriously. They say that ought to be the universal church. Buddhists believe essentially that view is constant with unity of mankind. Even the Muhammadans have that view, but then they have the view that their particular approach has got to dominate, as the Christians have, and as some others have had. So when you start arguing about what's better, Catholicism, Socialism, Muhammadism, or all these other things, then you're arguing about whether the cat can tell time. So you're saying, "Which of these are better?" You're overlooking the fact that you're splitting this very argument as well as splitting the one mankind.

## **Wilkins:**

I remember a Muslim professor of philosophy in Delhi who said to me in all his life, he had a very strong sense of these sort of other dimensions in life. Incidentally, it was he who was seriously reading David Bone [?] and [???] Whitehead. I looked up this professor other day and told him about a book, for example. I think I would like to have asked him

whether this clear apprehension of this other dimension to life did somehow sort of embrace this idea of unity.

**Bohm:**

I think the Muslims do because the word Allah is the god that cannot be defined at all. The whole idea of Muslim is that everybody should become a Muslim. That was the way the Muslim Empire developed, they said either Allah or death. And they were motivated by the notion of establishing unity. The trouble is that that way of establishing unity divides people. It's like overlooking the fact that the cat was talking. That very way is division, the way you concentrate on different ways of trying to make unity and which is better, you are engaged in division all the time.

**Wilkins:**

The Muslims seem to have gone in all different directions of crazy, fanaticism?

**Bohm:**

Also that they have mystical partner, Sufism and so on. On the other side, the Christians have done their

share fanaticism, and the Jews are getting into it now, and so on. It's a disease that all humanity is libel to.

**Wilkins:**

I think the scientists haven't tended to make divisions so much.

**Bohm:**

They divide in themselves. In science, they establish their divisions. They've established?

**Wilkins:**

But they don't go around fighting each other.

**Bohm:**

Well, no. Not yet anyway.

**Wilkins:**

I think one has to admit that the scientists have been better than religious people in not falling...

**Bohm:**

They do because they back up their nations in war. What impressed me terribly was to say, here in the middle of a war, there were those scientists that continued to work together in different nations that were fighting. That was rare. Most scientists were very patriotic and backed their nations, and many of them hated the enemy and so on just like everybody else.

**Wilkins:**

Yes. But Humphrey Davey had this thing about the scientists in one nation to fight scientists in another would be like civil war within science.

**Bohm:**

That was an older idea, you see. Now, with Star Wars, and such, that's changing.

**Wilkins:**

As you were saying, it was that World War I. So it's still there, so I do feel one can say that science is different from religions, and it's been less of this business of divisions.

**Bohm:**

Yes. But even to a certain extent, say the common Christian religion during the Middle Ages transcended the differences in nations.

Unfortunately, the Church got involved in all that, and that went.

**Wilkins:**

But if you take the whole history of science compared with the whole history of religion, I think the science comes out the better in that in that particular respect it does.

**Bohm:**

Yes. It may, but?

**Wilkins:**

They haven't gone around blowing up each other's labs unless they get mixed up in political differences like wars and so on, and of course in Germany and so on.

**Bohm:**

Some of the? Back with the Nazis?

**Wilkins:**

So being this kind of rubbish that's crept in, but all in the whole, that's been a minor side of science. So I think in the scientific community — it has something to do with the belief systems not being so dogmatic. I think that's what it is.

**Bohm:**

Yes.

**Wilkins:**

Scientists are a bit open-minded.

**Bohm:**

They are. But I think that this dogmatism is increasing as you get involved in this new society.

**Wilkins:**

I think you're probably quite right. It's getting worse now. Anyway, you were saying?

**Bohm:**

Anyway, sort of a theme of my thinking, probably which went through the next 20 years, that there is something obvious that we don't pay attention to, and that probably has to do with this question of unity. From the very moment when we think we're establishing unity, we argue about things that establish disunity.

**Wilkins:**

What you might say then is would you say that a sense of spirituality may necessarily entail some degree of feeling for this unity? Do you know what I'm saying?

**Bohm:**

Yes. I think it's essential to say that we have a fellow feeling for people with whom we disagree. And to say that that is not as important as people make it, that does not go so far as to say that the other person is evil and you can sort of mistreat them or kill them.



**Wilkins:**

Kind of the same as that.

**Bohm:**

Yes. So the notion is that particular views are not as important some general spirit with which truth is approached, and also in which a certain kind of friendship is maintained in spite of differences. The differences are not important enough to engage in destruction and violence. Once you do that, then I think you are caught in the business of arguing about the cat telling time. While the cat's talking merrily away you pay not attention.

**Wilkins:**

It's worse really because you end up with one cat killing the other.

**Bohm:**

Yes. But I meant that the cat talking stands for people killing each other while they argue about how to establish unity and peace. In the very way of trying to establish unity and peace they nevertheless are engaged in killing each other or destroying each

other. You have to begin by seeing this basic thing so that we don't go on with it.

**Wilkins:**

By the way, did you find one person at the meeting in Cambridge that you felt you had any sort of similar vibration with?

**Bohm:**

It was interesting enough, a fellow who works at Computers here in London, he was very mechanistic, but he was very open and we started talking. It turned out he was ready to listen to things.

**Wilkins:**

Ready to what? [glitch]

**Bohm:**

I hadn't got there yet, huh?

**Wilkins:**

No. You said that you, this story about cats or something was the last thing, which came up about Princeton. Now we're going to get on with —

**Bohm:**

Yes. So I think that's about all I'll say about Princeton, and now we'll get on toward Brazil. Of course it was early in October 1950 when I left for Brazil. I remember there was a hurricane in New York the night I left. Some of the streets were flooded. We finally left and it was little worrying because the plane taxied out and then taxied back. Somebody had something wrong with his passport. I didn't know who it was, but it turned out to be somebody else.

**Wilkins:**

They wanted to pull him off the plane?

**Bohm:**

They did, they pulled him off. Then we went again and finally got off. The hurricane had sort of more or less blown itself out. We landed in Puerto Rico and stayed for a while. Then went on to various, in those days you stopped in Corisou [?] and some other South American countries and finally landed in Brazil. When we got to San Paulo it was late, it was already evening. I had sent a telegram that I was

expecting to be met, but nobody was there. I called the University of San Paulo, but there's so many branches of it that there was nobody who knew how to deliver it. I should have said which faculty.

Therefore there was nobody there to meet me. I asked the name of a hotel and they gave me the name of a hotel in San Paulo and the taxi took me there. When I got there nobody spoke English. They gave me a room. I was getting worried. What was I going to do? I didn't know why they didn't meet me. I remember I went through some anxious hours, but I sort of calmed down by studying Portuguese. I was worried because I couldn't talk to anybody, you see. The next morning I phoned up the university and in English I asked for this fellow Tiomno, who's the man I knew. I had some trouble making myself understood, but they finally got a hold of him and he came to meet me.

**Wilkins:**

Did you say which department?

**Bohm:**

Physics.

**Wilkins:**

Physics.

**Bohm:**

It would've been Physicose [?] or something. I suppose somebody like an orderly had answered the phone and he probably had a hard time knowing what I meant. Then we came and they had put me in the Pension [?] there. It was a place where a lot of different people were staying from abroad. It wasn't all that comfortable, but it was all right in there. A terrible amount of noise there. I went to the department and we got established. Only about a week later I got really very ill, some sort of an infection.

**Wilkins:**

A stomach thing?

**Bohm:**

It started out in the intestine. The room apparently was a bit damp and cold at night. Finally somebody from the university came and got their doctor to come to me and they found a spot in my lung, noise

in my lung. So he said, Let's put you in a hospital right away. They put in there and gave me penicillin and it cleared up within a day. I was weak for a while. I had one or two of these bad infections in these early days because I didn't — Well I was eating only in the Pension, but later I ate in some of their restaurants. I didn't really know which restaurants were reliable so for a while I had a lot of trouble. The streets were really chaotic and noisy. You may remember them too. Terrible traffic. They had these streetcars, they called them bondis [?], which because it came from the word bond the English in the beginning of the century had sold bonds to set up a streetcar company. So their streetcar was called bondis. They made terrible noise. The people sort of crowded onto them. You had to squeeze onto them and hold on. I began to learn Portuguese. I bought a Portuguese-English dictionary and a Portuguese-Portuguese dictionary and various novels and started to read them. I studied the grammar. I had a small book with the grammar in it.

**Wilkins:**

But didn't the physics people speak English?

**Bohm:**

They all spoke English, but you evidently would need some Portuguese.

**Wilkins:**

Yes, for life generally.

**Bohm:**

And anyway, I was expected to give my lectures in Portuguese. The students were not all that good in English. They knew English to some extent so that I could always ask for help, but they wouldn't have understood a lecture in English. I fortunately arrived there just about the beginning of vacation, and it was a long summer vacation from say December until March, so I had four months. I began to work with this fellow Tiomno to continue this work on the casual Interpretation extending it into spin. But meanwhile, after I had not been there for very long, probably not even a month, some sort of Brazilian chap came into the Pension and said, They wanted

me to come down to the American Consulate. And I said, “What for?” He said, “Oh, they just want me to register.” He came with a car and we went down there. When I got there the Consulate took my passport and said that I wouldn’t get it back expect for return to the United States. Fortunately I had an identity card so I could stay there. That worried me a great deal for a while because I had hoped that I would be able to make a trip to Europe and look around. Anyway, I was wondering what their intentions were. He was very unfriendly, but sort of implied in what he said that they had no objections to my staying in Brazil, but they didn’t want them traveling anywhere else.

**Wilkins:**

What would’ve happened if you’d refused to go to the Consulate?

**Bohm:**

Well, the passport was only valid two years anyway so it wouldn’t have made much difference. It hardly would have been worth it.



**Wilkins:**

No. I agree that you wouldn't have wanted to act in a provocative way unless you knew you had to.

**Bohm:**

There was no point to being provocative at all. Nothing could have been gained and I might have lost something.

**Wilkins:**

You could have kept your passport. You could then have got to Europe and back.

**Bohm:**

Well, in the atmosphere that was there I had no confidence in being able to get anything. Don't forget that McCarthyism was at its height and Americans were having their passports taken away right and left. I mean that evening I left evidently somebody was unable to go because essentially they took away his passport.

**Wilkins:**

But once you were in Brazil they couldn't have taken your passport away unless you had actually gone to the Consulate, could they?

**Bohm:**

No, no. There would've been no point in it. That would have only been a delay because the passport was only valid two years and then it had to be renewed.

**Wilkins:**

Yes, but you would've been all right for two years.

**Bohm:**

But I wasn't planning to go to Europe that fast anyway. Anyway, I didn't know they were going to take the passport when he came for me anyway. I might have suspected it. You could say why should I get into worse relations with them by refusing to come?

**Wilkins:**

Yes, quite.

**Bohm:**

It became clear after a little while that they weren't going to bother me so I more or less forgot about it and got on with life. Not long after that this fellow Tiomno came to me and said he's moving on to Rio because he likes it better, his wife is there and so on. He was one of the main people I would be able to work with. There was another fellow, Walter Schutzer [?]. I was able to work with him later, but to a much smaller extent. This was a big blow in a way that I was sort of left alone.

**Wilkins:**

You mean you make an appointment there and you couldn't move to Rio.

**Bohm:**

No. The main person I would've worked with was gone. Later it turned out I had found one or two others, but I didn't know about that then. All that was depressing. It didn't get me down at the time

because I was determined that I would try to do something. The life in Brazil, I was trying to find out about it. In some ways it did remind of the earlier times in America. The stores were much smaller and businesses and so on. A little bit more like my father's little business when he had been starting out. It sort of had an air of small scale, which seemed reassuring because of these tremendous enterprises in America worried me, you know, they're so impersonal. There was nothing you could do about it. Nobody to talk to if you once got around the wrong situation. That was sort of superficial because basically there's only a small middle class in Brazil. Basically most people are either very poor or feel very wealthy.

**Wilkins:**

I remember that. Middle Class almost completely missing.

**Bohm:**

Yes. Perhaps there was more later, but at that time it was really very small. The university was for sort of middle class or some people who were a bit poor who were trying to raise themselves.

**Wilkins:**

And most of the staff had private means?

**Bohm:**

No. There was enough money. The salaries were not bad. I can't remember what their value was, but it was distinctly more money than I'd be making in America. Of course I had an assistant professor, American professor. That was probably a bit less than the American professor would've gotten, but not much less. In other words, I was not short of money and the staff really was very well paid. Compared by Brazilian standards, really well paid.

**Wilkins:**

Let me put it a different way. Weren't many of the staff, didn't they have private means in addition to their salaries?

**Bohm:**

Not those that I knew, no. There may have been one or two who did.

**Wilkins:**

But I thought that the impression I got back in Rio.

**Bohm:**

Maybe in Rio, but the people I knew in San Paulo — There were some who had private means, but most of them didn't. But their salary was adequate for a comfortable standard. The problem was not money, although later it probably began to be the state didn't have money to pay and sometimes months would go by before they paid you. Then later as the currency was inflating they had to find ways of paying you more. They gave us extra pay for night work. But at no stage was I really short of money. In fact, I accumulated quite a bit while I was there. My problem was really food. I met a fellow called Phil Smith who had been an American, who for some reason left America too. Was a little dissatisfied or something. He was in the Pension then. He had been there for a while. He knew Portuguese and he knew his way around and had friends. We found an apartment, he found it really. We furnished it and moved in, shared the flat. The remaining problem was to get food that wouldn't make me ill. I found

you could eat in one or two restaurants, which were really expensive restaurants by Brazilian standards, where everything had almost nothing but beef steaks and things like that, cooked stuff, cooked vegetable, then after every meal an apple.

**Wilkins:**

Peeled.

**Bohm:**

I peeled, yes. I kept off salads.

**Wilkins:**

Why didn't you cook your own food?

**Bohm:**

Well, I didn't really want to, and I didn't know if I would be able to. But I didn't really want to do it. It would've meant a lot of shopping and such.

**Wilkins:**

You mean you hadn't done it before?

**Bohm:**

No I hadn't in America here and in Brazil I would have to find out where to —

**Wilkins:**

What to buy and where to buy.

**Bohm:**

What to buy and where to buy it and so on. Also my language in the beginning in Portuguese wasn't up to it. I was slowly learning Portuguese. I could make myself understood to buy simple things, but I mean any difficult question I couldn't have made.

**Wilkins:**

How long had you been there when I visited you?

**Bohm:**

It must've been well over a year.

**Wilkins:**

I think I remember you saying that you had more or less perpetual diarrhea.



**Bohm:**

Yes. I never really solved the problem. I think their bacteria in the environment there which irritated me. I think the restaurant was very good, some of the restaurants, but I couldn't quite solve the problem of all this diarrhea. So I was eating in mainly expensive restaurants. The other restaurants are really dirty. I ate once in one of those unusual restaurants and within a day I was very ill. The doctor said he thought it was salmonella and he gave me some sort of Oriamiacyn [?] and that cleared it up after a while. That was one of my problems that it was hard to get the kind of food I wanted. The heat was another problem. I didn't like it.

**Wilkins:**

The what?

**Bohm:**

The heat, it was rather too warm for me although San Paulo was not as bad as Rio. San Paulo is nice in the wintertime. It was just about an ideal climate. The summer was very rainy and muggy and hot. The other problem of course was lack of people to really

work with. I had assistants. I had several assistants. The only one I could really work with was Walter Schutzer. We did some work after a year or two on probability, trying to understand probability theory in physics.

**Wilkins:**

Do you mean that apart from working with Schutzer you were able to really do very little work at all?

**Bohm:**

I would do my work on my own, but you see, I had nobody to talk with very much. For quite a while anyway. I improved it a little later through several ways that I'll explain.

**Wilkins:**

But it wasn't like the Princeton situation then when it was quite helpful not to have people to talk to.

**Bohm:**

No. It was really too much and too long.

**Wilkins:**

Exactly. There are times and places you mean for being isolated.

**Bohm:**

Yes. Also the city is a hard city. It's noisy. You can't relax there with all that traffic.

**Wilkins:**

Yes. I hear it is a horrible place.

**Bohm:**

It's worse now, but tremendous contrasts of wealth. People coming into the city, men and women sleeping on the streets with their babies under the big skyscrapers. Outside on the edge they have all the pavellas [?], all the slums. Very poor people. You know, this contrast with wealth and poverty. I think that I found it a bit wearing. I began to improve to situation. I talked with Schutzer and he suggested that I could get some money from the National Research Council to bring somebody here from America. There's a fellow called Peter Bergman I knew. I had a student named Ralph

Shiller who said he would be ready to come. He was interested in my work. So we got enough money finally for Shiller to come down. With Shiller we continued to work on the various things including the work I'd done with Tiomno extending the Theory of Causal Interpretation to the spin. That made it more interesting and also somebody more to talk with all around. He came with his wife and they got themselves an apartment. They stayed two years. Then during one summer I managed to get money to bring this fellow Vigier for about a month or two from Paris. He was interested in the Causal Interpretation. While he was here we worked out sort of a statistical version of it, a stochastic version, which we had random Brownian [?] motion added to the motions of the particles to help explain the statistics. We discussed a lot of other things. He was very much of a left wing. He was a communist and he was working with DeBroglie. That's how I got to know him, but DeBroglie recommended him.

**Wilkins:**

Was DeBroglie left wing?

**Bohm:**

No, but DeBroglie wanted any support he could get for his work, because in the meantime DeBroglie, as a result of my paper had gone back to his earlier ideas. There were a few things that happened. I was in fairly regular correspondence with Einstein during this time. I wrote letters also to these people, the Collars [?] where I used to stay. Eric Collar and Lily. I have copies of some of those letters. I was complaining quite often about being ill and the terrible situation in Brazil, the absolute chaos and the complete corruption.

**Wilkins:**

Have you got any of Einstein's letters?

**Bohm:**

Yes.

**Wilkins:**

The originals?

**Bohm:**

Yes, well copies of them yes.

**Wilkins:**

You've got something then. What did Einstein write about? Was it physics or —

**Bohm:**

We talked about the bad situation in Brazil and he said that he understood and he understood my troubles with the stomach. He had similar troubles.

**Wilkins:**

Did the fact that he was a Socialist come out?

**Bohm:**

No. But he understood my problems in Brazil, but he said it was no use returning to the United States because I would not get a job. We talked about some questions in physics. At one stage he wrote a paper criticizing the causal interpretation and a volume from Max Bohn. He gave me an opportunity to reply, and we have that. There's also a fellow called Mario Bunge who came up from Argentina and was interested in the philosophy of science. Before I got to Brazil I was beginning to get interested in philosophy more strongly because for one thing this

question of causality interested me. The Bohn interpretation, which I had favored, seemed to say there was no question of objectivity or causality or anything. I sat here with this new interpretation. It came up again so I wanted to understand what was meant by causality. I began going to what people had said about it philosophically.

**Wilkins:**

What was the new interpretation?

**Bohm:**

That it was causal mine, yes.

**Wilkins:**

Your interpretation.

**Bohm:**

Yes. So I was interested in general philosophy and the nature of things. I found the brother of Walter Schutzer was in the philosophy department and we used to have some discussion on Greek Philosophy. It was no wonder we had, but they sort of got me started. I used to go on this vacation to a mountain there called Compass Dejurdan [?]. It was about a

mile high where it was a bit cooler and where there were forests and so on, which I found very invigorating. Every time I came back Phil Smith used to say I looked disgustingly healthy, but that look soon vanished in about a week living in San Paulo. Once we went with Jean Pierre Vigier when they were there and also a fellow called Yevick. I haven't told you about him. I should have mentioned that in Princeton some of the people that I knew, in addition to Melba Phillips and my two students, Eugene Gross and David Pines and the Collars, I knew Yevick. George came to one of my talks in Princeton very early. He was interested in it and he invited me to his home. I met his wife Miriam, who was a mathematician. I used to see them quite often and talk about not only physics or philosophy, but also politics and all sorts of things from this generally left wing point of view. He came down during that summer also. We went together to this place in Compass Dejurdan. We talked about all sorts of things including the Dirac Equation, trying to make a causal model of the Dirac Equation.



**Wilkins:**

I thought you said the act of creation. The Dirac Equation.

**Bohm:**

The Dirac Equation, yes. So we had people from time to time, but on the whole I felt a bit isolated. After two years the Shullars left and there was nobody else around. I did work with Walter Schutzer on probability theory trying to explain to some extent why probability theory works. I don't know if I should go into the details here.

**Wilkins:**

What sort of probability theory?

**Bohm:**

Any probability theory, in physics you see that. I tried to explain about what is now ideas which are essentially those that have come up in modern chaos theory to say that particles move in a complex system in a chaotic way, highly unstable, so that they move in very irregular orbits and the slightest perturbation will change them radically and so on.

That way I tried to explain why some regular trends might arise in this chaos so on the average the probability theory would apply. In general I was dissatisfied with probability theory. It seemed it was only a formalism to crank out to get results. You didn't understand why it should work at all. That was this business we were talking about the informative and the explanatory power of theories. Probability theories were mostly informative with very little explanation in it. It gives you information, but you have no?

**Bohm:**

That will cover the same general —

**Wilkins:**

Given enough time, the initial conditions don't matter.

**Bohm:**

Don't matter, yes. That's essentially what you show. That was a way of justifying probability theory, explaining it really. Of course I was interested in all of the philosophical questions at that time. I began to think of writing a book on causality. At this time

another fellow, this fellow Mario Schoenberg returned. He'd been in Belgium. He'd been more or less exiled from Brazil. He'd been a communist and very active politically. At some stage he'd been arrested and imprisoned for about a week. Finally he left Brazil just before I came.

**Wilkins:**

He's lucky it wasn't longer, knowing that country.

**Bohm:**

Yes, but he was ill so he spent most of his time in the hospital. He left Brazil for Belgium just before I came, apparently. There was a lot of intrigue going on there about people were intriguing against each other all the time and trying to get each other kicked out.

**Wilkins:**

Within the university?

**Bohm:**

Yes. You know, making the situation intolerable for each other.

**Wilkins:**

You mean to get the other person's job or something?

**Bohm:**

To get rid of him, you know, just to get him out. Probably to consolidate their own power. There were all sorts of factions. I didn't know anything about this in the beginning, but I began to sort of sense it later. There was intrigue against Mario Schoenberg because of his politics. Also just simply personally everybody is bound to have somebody who doesn't like him. He finally came back. I could sort of sense that there was a dislike of Mario Schoenberg. They were prejudiced against him among some people. Others didn't, others favored him of course. But he came back and he was in a much higher level scientifically than the people I'd seen so far were. He understood a lot of physics and he understood a lot of philosophy. He was also very interested in art and he had close associations with artists. He belonged to the artists' club and his wife was a [???] I believe. He had some very broad interests.

**Wilkins:**

Why did he want to go back to Brazil?

**Bohm:**

Finally it became clear that he could. He had no really permanent position in Belgium so it wasn't a satisfactory situation. I think we began to discuss physics more and many different physical ideas and so on. I can't really point to any of them. I had been discussing causality and essentially through discussions with Schoenberg had turned into more a dialectical direction. That is he was very interested in dialectic. He used to say that Lenin had said communists should read Hegel, and very few did. We did discuss dialectic and especially the question of causality and its opposite, which was chance with contingency really. Necessity and contingency were the two basic categories. Necessity is what cannot be otherwise and contingency is what can be otherwise. Necessity doesn't yield, but contingency yields. It depends on things and so on in that contingencies are external. Well of course, these two qualities interchange. Because what was necessity seemed to be a contingency we looked at, it depends, actually

within in a certain area it's necessary. But when you broaden the context it's contingency. What was contingency is seen as necessity. Like a very large number of random events, which are contingencies add up to kind of statistical necessity. The first thing is that the two categories weave together. They become each other; they turn into each other. They reflect each other because in necessity you see a reflection of contingency and vice versa. Eventually at bottom they are each other. They cannot really distinguish them. Contingency is necessity. Contingency first of all is necessary.

**Wilkins:**

They're not opposites are they?

**Bohm:**

They are opposites, yes.

**Wilkins:**

They are opposites.

**Bohm:**

They are, because necessity is what cannot be otherwise and contingency is what can be otherwise

exactly opposites. They're opposites, which become each other and reflect each other and eventually identically.

### **Wilkins:**

So that their interaction gives rise for process of change of one into the other.

### **Bohm:**

Transformation, yes. The one turns into the other in, which remains identical, and so on. It seemed to me that this dialectical deal, causality, was far better than the simple view which I had been looking at, which was to just simply try to accept causality and try to work out what it was and how it worked. I was interested in writing my ideas on the subject, and I began to write them out in chapters and it was gradually forming a book. I wrote a book from that point of view: Causality and Chance in Modern Physics I called it. I just about finished most of it when I got out of Brazil. I finished it finally in Israel, but the basic thing was done in Brazil. It was written to start out by just going into different kinds of necessity and causality. Then I mentioned mechanism as a basic form of causality and into all

of its different developments starting with deterministic mechanism new to them. And saying that the idea of chance as done in physics was at first seemed to be a step away from mechanism, but eventually it became just as mechanistic. Like saying that if you have a pinball machine with chance it's still mechanistic. Because the essential quality of mechanism was to some fixed set of rules and some dependence on the outside. The essential quality of mechanism was that first of all, you followed a fixed set of rules, and the thing was not internally related to the outside, but only externally related by some secondary superficial things like impingement and so on. Therefore, science was constantly moving toward a mechanistic view, a retaining mechanism each time it seemed to be changing. It went from a particle theory to a field theory, which enriched the ideas. It would seem to be move away from mechanism. But finally it became mechanistic any way. The assumptions were put in that form.

**Wilkins:**

What happened to this book?



**Bohm:**

It's the book I've written, *Causality and Chance in Modern Physics*. I wrote that book and I included my new interpretation in there. Then the idea of the qualitative infinitive nature to say that — I said nature was not limited, but was infinite in its qualities. Therefore every cause of law was limited by contingencies from beyond its context. Every law of chance was limited by cause of laws from beyond its context. The two kinds of laws wove together in an infinite, very rich structure with no limit. That if we're always working we could extend it as far as we liked, but it would still always be infinite, the amount we haven't learned.

**Wilkins:**

Did this dialectal thinking he gave you was then usefully applied in your book?

**Bohm:**

Yes. I had this idea of a qualitative infinitive nature, which translated for me to some extent that idea of the science fiction story that I'd been writing, saying nature was infinitely rich and all woven together into

one whole, that opposites were woven together in this dialectal way dynamically. I think it was a continuation of that vision. It sort of liberated me from the idea that nature could definitely fixed and known once and for all.

**Wilkins:**

The unity then in nature is in a constant process of change.

**Bohm:**

Yes, in transformation. There's no end to it. There's no bottom to it.

**Wilkins:**

In other words, you might almost say it's alive.

**Bohm:**

Yes, but that was also what was implicit in my science fiction story.

**Wilkins:**

You mean the science fiction story about the people in the spaceship.

**Bohm:**

These beings and also the human beings who learned this and saw that there was no point in this conflict.

**Wilkins:**

So that you went into the nature of this unity in that science fiction?

**Bohm:**

Yes. I felt that I was really unfolding — that this interest in philosophy was aimed — I think I began to realize just about the time I was leaving Princeton that we had been accepting all sorts of philosophical ideas, taking them for granted without knowing if that was part of the cat dream scene, all these things we had never looked at. For example, we just said causality and then we thought, you know, we're talking about, argued about it, but the main points we just took for granted.

**Wilkins:**

Has that book stimulated other people to develop ideas further?

**Bohm:**

People have read it and some people have been stimulated in some way. It didn't have the effect that it might have had. Let me say what happened later. I sent this book to Eric Burrup [?] and he passed it on to Normal Franklin.

**Wilkins:**

Who's Normal Franklin?

**Bohm:**

The editor for Rutledge and Kegenpaw [?]. He is the brother of Rosalind Franklin I think. Franklin agreed to publish it after I made some revisions. It was published just about the time I got to England. It got a number of reviews, which were good, but the philosophical fraternity paid very little attention to it because I'm not one of them. And also that's not the sort of idea they wanted to hear. They want to hear some careful little bit of work sort of imitating what they think scientists do. The philosophers say we must each work on some tiny little thing and all together we will make some big structure of truth

perhaps. It's not like the old days of philosophy. It's very modest now.

**Wilkins:**

They wanted little technical points and you gave them framework.

**Bohm:**

Yes. Probably they didn't quite see what to do with this anyway. Various different kinds of people have read it and have been affected in some way by it.

**Wilkins:**

But times have changed in philosophy haven't they?

**Bohm:**

Well, no, it's not really very different now. But do you remember L. L. White? Lancelot White. He read the book and he liked it very much. In fact he wrote to Rutledge saying that they should really push it more and say that it was an important book, but they never did.

**Wilkins:**

Which White is that?

**Bohm:**

He's dead now, Lancelot White. He was sort of a generalized philosopher of some kind. He was quite an interesting man. He wrote a number of books. But I mean there were few people, who appreciated it like that, but in general it sort of sold slowly and then finally they discontinued it. But they've reprinted it now recently.

**Wilkins:**

You mean interest has increased.

**Bohm:**

Yes. I think that book was basically a result of Brazil. I think in Brazil the main thing that happened was that my ideas transformed a great deal.

**Wilkins:**

You had the dream and science fiction idea in Princeton.

**Bohm:**

In Princeton.

**Wilkins:**

But this Bohr fruit in Brazil.

**Bohm:**

It began to bear fruit in Brazil. Being far away from people had this affect that I really went much further into these philosophical things than I would've done probably elsewhere. I did meet Mario Schoenberg who helped. I think it was a period when I was in sort of a change looking at these assumptions, which were being taken for granted, as in the dream about the cat, you see. Scientifically not a lot Bohr fruit, but the main thing was probably this book.

**Wilkins:**

You're saying that that was more philosophical than scientific?

**Bohm:**

Yes, but there was some science and it was more philosophical. But I was trying to get free of all sorts

of rigid assumptions, which were generally accepted. And also trying to realize this dream in the science fiction story. I think I still believed in it, which if people could really see science in another way people would change. In other words, it would be a very powerful factor for bringing about unity and peace and raising people's hopes. Being in Brazil helped me to look at it that way because I wasn't in contact with what was really going on in science. I wasn't constantly learning that it was quite different.

**Wilkins:**

Would you have said that the way that science has developed has affected the way people have developed?

**Bohm:**

It has developed in a rather negative way. I mean it's almost the other way. That the mess that people are in has spread into science.

**Wilkins:**

You mean the clarifying element in science has tended to sort of cloud peoples understanding of themselves if anything?



**Bohm:**

Well, because they looked at it so narrowly. I was trying to say if you look at this whole process, which I was trying to confront in the book, then you would not make this separation of the human being. It would say causality and chance interweave both between human affairs and nature in this infinite process without bottom or top, constantly transforming.

**Wilkins:**

So that for example the scientific facts about the natural world would weave into the human values area?

**Bohm:**

Yet. In fact just seeing this interweaving of causality and chance would affect human values in the sense that human beings wouldn't hold rigidly to certain fixed ideas, or they would know that whatever they are doing they are subject to contingencies and they must be ready to meet them. At the same time whatever necessity they set up and the other way around, that when various things which seem to be

unrelated and meet in a contingency that that is the occasion for a creative move to see a new meaning there, a new necessity. In a way, Monou [?] has this in a very distorted form. He made almost a parity of it. Monou said you have chance and necessity. So he said you have a whole bunch of chance combination of molecules. Then they start of a mechanical chain of necessity. That's a parity of this thing.

**Wilkins:**

You mean that was really very negative.

**Bohm:**

It said apparently the same thing, but it came up with the essential meaning lost. The whole point is creativity. That when a whole bunch of things comes together, apparently contingent, then in that moment a new opportunity arises for a creative response to that whole new thing to see a new meaning of it all, which unfolds a new chain of necessity in a creative way.

**Wilkins:**

Wasn't this implicit in Hegel?

**Bohm:**

Yes it was, but it was not implicit. Monou turned this into a parody of that.

**Wilkins:**

Yes. Certainly my impression was Monou was just the opposite.

**Bohm:**

He took something formally the same and turned it into the other.

**Wilkins:**

What I'm getting at is why wasn't this potential, as Hegel received a lot of attention in Germany in his time, I mean why wasn't some of this potential expressed more in German philosophical thinking?

**Bohm:**

That's because I think of the Industrial Revolution. That's why I try to say people like Goethe and Hegel

had this idea, but the general trend went against them because everybody wanted to make money and get ahead and get a useful product, so they said all of this is cloudy abstraction. We don't care about it. We want to get down to the real stuff and make money.

**Wilkins:**

He has enormous following in his lifetime.

**Bohm:**

He had. It didn't affect the fact that science was being pushed to a large extent in Germany by the development of industry.

**Wilkins:**

So you mean it was romantics largely that was interested in his philosophy, whereas the economic, technological development was not in the hands of the masses?

**Bohm:**

No. It was in the hands of people of very narrow interests who primarily wanted money and power.

**Wilkins:**

But to some extent I suppose the Marxists —

**Bohm:**

Well, Marx claimed to have turned that upside down. See we will have to discuss Marx later. But I mean there was a bit of romanticism in Marx too.

**Wilkins:**

But it was creative in a degree.

**Bohm:**

Yes. But then I mean again it got turned upside down. Just as Monou turned it upside down, the people who followed Marx turned his stuff upside down.

**Wilkins:**

I don't quite see why the materialists turning it upside down would destroy its essential creative —

**Bohm:**

Because eventually they got caught in the same thing that the businessmen got caught in, that they began

to minimize the importance of spirit. When Russia said we've got to establish communism, Lenin's slogan was, "Communism is Soviet Power, plus electrification." Where was the spirit?

**Wilkins:**

Yes, but originally in Marx there was this spiritual revolution.

**Bohm:**

That's right, but once the time came to put it into power then the spirit went. They had the same problems as the businessmen, he's first got to survive and get ahead in business.

**Wilkins:**

So really you would say that Marx's materialism sort of destroyed the central creativity —

**Bohm:**

It needn't have, but in a way it was probably bound to. Constant stress on the material side would gradually erode the spiritual, right.

**Wilkins:**

Yes.

**Bohm:**

I remember in Brazil I used to think a lot about what was going on in the socialist countries. I had heard some terrible things. They said their scientific work was of mediocre quality and grinding away. I tried to say well maybe they've got to spend a generation or two just grinding away to lay a basis and then they will flower later, but that was wrong.

**Wilkins:**

It affected them in the process.

**Bohm:**

They lost the whole spirit.

**Wilkins:**

Maybe they'll recover a little bit of it through Gorbachev or something.

**Bohm:**

His power is very limited. He's got to go along with whatever the country is ready to do.

**Wilkins:**

We've got to have some sort of hopes. We have to have some hopes for the labor party and some hopes for this.

**Bohm:**

Some small payment for the Republicans in American who put up sanctions, who agreed to sanctions.

**Wilkins:**

Yes, who knows? It can always be the unexpected and unforeseen.

**Bohm:**

That's right, but that's this contingent combination of events which opens the opportunity to new creative necessity flowing out. The point is not that you can plan creativity. That's where socialism also went wrong. But rather combinations of events



which open new opportunities creatively and must open it and it must move and see their meaning or else you lose it.

**Wilkins:**

You mean the creativity produces a necessity.

**Bohm:**

The creativity sees the meaning of necessity, and seeing that meaning you —

**Wilkins:**

Recognizes the necessity.

**Bohm:**

I would say perceives the necessity. Recognizing it would be to know it again, but you didn't know it before. Therefore I would say it perceives necessity. Then you've got to keep on seeing it. Of course recognize it once you've seen it. But the idea now is that seeing necessity, that necessity is created by the human being himself. He sees that necessity, and then he moves ahead not yielding along that line, which creates the very necessity. The new necessity is not just a mechanical necessity. It's not like

Monou saying a whole bunch of events comes about and then it starts a new mechanical chain, which grows entirely by itself. But rather various combination of events combined with the creative perception that was not there before at all. In Monou's view it was all there before, but it just rearranged.

**Wilkins:**

There seemed to be nothing dialectical about all of those things.

**Bohm:**

That's entirely mechanical, and it's uncreative.

**Wilkins:**

It's terribly barren.

**Bohm:**

The point is to say that the creative perception of a new necessity is the new necessity. In Monou's view, the perception of necessity really shows the existence of the necessity, which would happen any way mechanically. But in this view the creative perception of the necessity is the factor, which

makes the new necessity come into realization. Suppose you see a combination of events happen and you suddenly see the meaning of that, that it's an opportunity for something new, and if several people see it they actually do it and then something new comes. And they stick to it, which is the necessity.

**Wilkins:**

It's like coming out of suffering, that when things go wrong it just then creates an opportunity to follow it up with things coming right. Uplift. I mean that suffering can produce —

**Bohm:**

Yes, but I mean not really suffering, but any particular unexpected combination of things will have a meaning of possibility that you see at that moment.

**Wilkins:**

And that I think in particular the things which appear to have just the opposite.

**Bohm:**

Yes that often happens. It seems that the necessity as Hegel put it is to lay you low. That the various independent factors you have are laid low by what appears to be external necessity, which is suffering. But actually that is the destiny of all of these factors to do that. Once they've done it, you see that they were really implicitly each other really. Each one was implicitly not only related to the other, but really was essential, a factor of the other. When they met then if the meaning is seen, then a new reality comes into being creatively, which then uses those other things as factors rather than just mechanical, you know, just the main things. Therefore it's not really possible to, this idea of planning socialism and so on. You have to make plans, but to make that the key point is really going to lead you astray. Making plans is a side issue.

**Wilkins:**

You have to do planning and anti-planning.

**Bohm:**

Yes. The main point is you have to be free enough to take and manage these combinations of events creatively. One knows that people in the West have not been creative, but it wouldn't solve that the Russians were even more rigid and that they failed to take advantage of combinations. For example, you have such a thing as this Korean plane flying over their military base, and they were unable to coordinate themselves sufficiently so they didn't shoot it down. They didn't realize you can also be very destructive if you don't meet these combinations properly. They set the whole very bad thing in motion by that. So being able to meet these combinations is creative; not being able to meet them is destructive. We didn't have all that worked out there in Brazil, but it was kind of implicit in what I was doing. I felt that all of this was really a continuation of (at least I feel now, I didn't feel then), that this was a kind of continuation of the dream of the science fiction story. So that if we could really understand the nature of things deeply then we would see such unity that we would not go on with this crazy strife. We would really focus on the main point and not on these side issues as in the dream of the cat. Of course I found life very difficult

in Brazil, especially as people moved away and the heat was bothering me, the food. The whole thing was depressing because it was all intrigue and chaos and the universities really had essentially only a very few students came. We didn't see much point.

**Wilkins:**

What were students doing? Going to be engineers and —

**Bohm:**

Various things, I can't remember. But the number of students seemed ridiculously small compared with the size of the staff.

**Wilkins:**

Not physics you mean.

**Bohm:**

Yes. One didn't see how the whole thing really had very little point. I was getting isolated. And I thought I'd like to get away, and so I was looking into it.

**Wilkins:**

After how long was that?

**Bohm:**

About three years.

**Wilkins:**

Three years. So I met you after about one year.

**Bohm:**

Yes.

**Wilkins:**

So you went two years after that.

**Bohm:**

Yes. So I was thinking I'd like to get away. There had been a fellow who came called Corsiti [?]. He worked as an experimental physicist, but he went to Israel. He put me in contact with Nathan Rosen, who is a theoretical physicist who had worked with Einstein who was there in Haifa at the Technion. I found out that there was another fellow I had known in Berkeley called David Fox. I let them know I was

interested. After a while they made me an offer, not a very good one, but I thought I'd take anything just to try to get away for a while anyway. It was my first plan was to say I'd go there for a while and I would just take a leave of absence from Brazil. Meanwhile I had the problem of the passport.

**Wilkins:**

You hadn't had it for two years. You hadn't got it, anyway.

**Bohm:**

I hadn't got it, so I was wondering should I go down there and ask them for one. But I said I didn't know if they had found out I wanted to travel and maybe they would make trouble for me in Brazil. Finally I thought maybe I should take Brazilian citizenship and then I would have a passport. After a lot of consultation I wrote and discussed it with Einstein and a few other people and I did that, I got Brazilian Nationality. A little bit after that I went to Europe and then to Israel. As you know, I remained a Brazilian National until recently when an American Lawyer told me that I might be able to get the American Nationality back.



**Wilkins:**

I hadn't actually realized that you had a Brazilian Nationality. I knew you hadn't got the American one. Was it fairly easy to get Brazilian Nationality?

**Bohm:**

In my position it was, being a professor and so on.

**Wilkins:**

And you being there three years.

**Bohm:**

Well, five years would be normal, but being as a professor you only had three years. No, that wasn't any problem at all really.

**Wilkins:**

So you kept away from the Americans completely.

**Bohm:**

Well, I didn't know what to think about them because it was a very bad period.

**Wilkins:**

That was probably very wise because the McCarthy business was still carrying on.

**Bohm:**

Yes. And I said for all I know they would try to get me thrown out of Brazil.

**Wilkins:**

I think they can. Where did you go first when —

**Bohm:**

To Israel.

**Wilkins:**

You went straight from Brazil to —

**Bohm:**

No, I passed by way of Paris, and we had a trip to London. I remember Jean Pierre and I went and visited Eric Burrup.

**Wilkins:**

You visited Eric Burrup straight after you left Brazil?

**Bohm:**

First to Paris and then the two of us made a trip to London.

**Wilkins:**

The two of you?

**Bohm:**

Jean Pierre and Vigier and I made a trip from Paris to London.

**Wilkins:**

Meeting him in Paris you mean?

**Bohm:**

Yes.

**Wilkins:**

Had you been in touch with Eric Burrup?

**Bohm:**

Only very indirectly.

**Wilkins:**

Were you writing to him?

**Bohm:**

I don't remember whom I wrote to. How I got in touch with him I can't remember. But he was the one who somehow got my manuscript. Who did I send it to? Perhaps I must've sent it to him, I don't remember. Oh, yes, it must've been him. You see I remembered I sent him a copy of my manuscript and through him it got eventually to Norman Franklin's hands. And maybe it went through Bernal for all I know. I thought I would see him again because I had known him quite well in Berkeley.

**Wilkins:**

He was a theorist of physics so it was —

**Bohm:**

Yes.

## **Wilkins:**

He was an obvious person to see.

## **Bohm:**

And I thought he would make some suggestions about England and so on. It turned out he had no suggestions. But what happened there was that I gave a talk in University College on the Causal Interpretation including the spin, which was well received. John Bell was there. He was a young physicist who later went to Geneva and he later worked out this Bell's Theorem which people talk about it a lot on locality now. He was affected by this talk. He had believed that there was no way to understand quantum mechanics causally. Then suddenly he said, "Here it is in front of you." That talk had an effect on Bell. I tried to do some work with Jean Pierre there in Paris. We talked about a lot of things. I don't know if he managed to do very much work, but I sort of looked around. He lived under rather primitive — He was living in one of those old places in Rue de Bosarn [?], unheated flats on the fifth floor and you had to climb. He had a couple of small ones with his wife and kids.

**Wilkins:**

He didn't have much money?

**Bohm:**

I suppose not. I think Paris was still a very poor at '55 after the war. I remember when we went to Austria with Sara in '56, Vienna was fantastically poor. Not only the war, but also the Soviet occupation certainly left them in a miserable stand.

**Wilkins:**

It's odd because when people write about Rosalind Franklin coming from Paris in the very beginning of 1951, the whole line is that she had such a wonderful time in Paris and the food was so much better.

**Bohm:**

Well, I'm sure the food was a lot better than in England. When I got to England the food was terrible. I mean the food wasn't bad. It was just that the living conditions were bad. The food was far better than the English food.

**Wilkins:**

I think the other thing was that the Franklin's are quite about —

**Bohm:**

Yes, if you had money you could do anything. You could've gotten very good conditions there. But I'm sure [??] didn't have that much money. A tremendous number of people lived in rather poor conditions.

**Wilkins:**

I think is one thing which the playwright Harry Well [?] has rather stressed in talking with me that people normally sort of pictured Rosalind Franklin as being sort of in many ways a very deprived martyred type of person. But in fact she in one respect at least she was the opposite because she came from quite a wealthy family. I think that she need never have been short of anything of a material nature. That didn't mean of course that she wasn't deprived in other ways.

**Bohm:**

She was deprived in other ways.

**Wilkins:**

Very severely indeed.

**Bohm:**

I found Paris a bit hectic. I think it part Jean Pierre. He was so busy with his political activities and he would spend vast amounts of time suddenly going off to a communist party meeting. He'd put that first, and I began to get a little annoyed that I'd come all this way and he was spending so much time at these other stuff. Both he and his wife were then dedicated communists.

**Wilkins:**

As a communist, what interest did he have in this dialectical aspect?

**Bohm:**

I don't think he understood it at all. I never managed to talk it over with him.



**Wilkins:**

Why do you think he didn't understand it?

**Bohm:**

Just simply first, he wouldn't talk about it, and secondly his subsequent work shows that he thinks very much the same as all the other physicists.

**Wilkins:**

So you mean that the dialectical theory from Marxism didn't really get through to him.

**Bohm:**

I never found a communist other than Mario Schoenberg to whom it did get through.

**Wilkins:**

It's very odd, isn't it. I never really studied Marxism at all, but as an undergraduate I read any odd thing here or there. I must say all his dialectical stuff, I didn't have the foggiest idea what it was about except quantity and equality and things like that. I could see very simple notions. It's only very recently that I began to find out little bits about —

**Bohm:**

See it's subtle and not easily appreciated. And most communists operate at a very naïve level. They're just thinking of getting results. They're not so different from the businessmen. They just want a different set of results that all.

**Wilkins:**

I think that unfortunately is true.

**Bohm:**

Basically, there's not a great deal of difference in the way most people think. You see the popularity of things like rock music in the Eastern Block. That's much the same. Dialectical material has had the least possible affect in the Eastern Block. Somebody like Stalin simply would suppress it. He wouldn't want the slightest bit of it. He wants everything to be rigid and well planned and organized. The name he chose for himself, Stalin, means steel.

**Wilkins:**

But in the first few years after the Revolution there seems to have been an immense amount of artistic and [???].

**Bohm:**

I'm sure there was a lot of intellectual firm the first few years, but Stalin killed off almost all of the people that were involved. He frightened off the rest so that they wouldn't think of these things.

**Wilkins:**

I suppose that they felt it was very difficult to push through the big changes they wanted in industrialization and so on and keep this degree of open [???].

**Bohm:**

Also they felt that they were being attacked from the outside.

**Wilkins:**

That of course is true.

**Bohm:**

It was true, but then that was the challenge they faced. If they didn't face the challenge it was useless. They should've left it in the hands of the Czar.

**Wilkins:**

But as you were saying, that if you didn't react properly to the difficulties you turned it into a sort of negativism, destruction, and sort of death in life. They failed to make use of it. In a way one had to turn these negative factors into one had to [???].

**Bohm:**

There were plenty of people in the early days who were ready to do this, but these people who wanted the thing to be well organized and so on got rid of them. It's not to say that people who are under challenge and tension can't do this sort of thing. In fact they're more likely to do it than otherwise, but not if from within they're being threatened and killed and whatnot. The ordinary people were ready to go along because the government painted such a picture of how dangerous these people were. It was

really a false picture. The danger was what Stalin was doing. That is one of the problems that insofar — It was only natural to make this mistake, but when Lenin says communism is Soviet power plus electrification, that was the mistake. The thing cannot be — neither Soviet power nor electrification can be the main point of that is at issue.

**Wilkins:**

I agree it is a rather peculiar, what sounds of any sort of limited view, but presumably —

**Bohm:**

But I mean what he was thinking was once we've solved all of this then we will have a good material base and then we'll open up. I'm sure that's what he was thinking.

**Wilkins:**

I'm sure they were right to think the material base was very important to push ahead for, but it wasn't enough, was it?

**Bohm:**

Well, no, but unless you preserve this other thing during this period there won't be any left. In fact they never even got the good material base. They never even arrived at it.

**Wilkins:**

They've got a much better material base, better than they had before.

**Bohm:**

But they never arrived at a really good one. They sort of reached a self-limiting situation where the whole society is too corrupt to greatly improve it.

**Wilkins:**

Gorbachev tried to —

**Bohm:**

Gorbachev was trying his best, but he's only one man.

**Wilkins:**

Anyway, they recognize more than they did where things have gone wrong. So you saw Eric Burrup, but there didn't seem to be any job possibilities in England then.

**Bohm:**

No. I also went over to King's College and talked to somebody. It all looked very limited at the time.

**Wilkins:**

Which King's College?

**Bohm:**

Your place in the physics department.

**Wilkins:**

Did you?

**Bohm:**

Yes.

**Wilkins:**

I must've been there.

**Bohm:**

But I didn't know about that. There were young men I talked —

**Wilkins:**

You mean you didn't know that I was there at that time?

**Bohm:**

No. I didn't know where you were. I'd forgotten.

**Wilkins:**

Because I was. Biophysics hadn't spit off at that — What year was that then?

**Bohm:**

'55.

**Wilkins:**

Biophysics hadn't spit off then. It was still in the physics department. You presumably talked to people in the theoretical?



**Bohm:**

Yes I did. One or two young men, they weren't very encouraging. They said there wasn't much.

**Wilkins:**

Who was the —

**Bohm:**

I can't remember any more.

**Wilkins:**

Theoretical physicists, was it Longertaken or Coolson?

**Bohm:**

I can't remember any more.

**Wilkins:**

Maybe it was Coolson probably.

**Bohm:**

I really can't even remember that.

**Wilkins:**

I would guess it was Coolson and I would've guessed probably that Coolson was not the sort of physicist that you would've —

**Bohm:**

I had the impression that whatever they were doing wouldn't interest me and what I was doing wouldn't interest them.

**Wilkins:**

You're probably right. It might have been very good in its way but.

**Bohm:**

And of course at that time I was worried about it was hard to get good food here in any reasonable restaurant. Did I do anything else? Yes, I think I went to Cambridge and saw somebody. Who it was I don't even remember now. But it was Buneman who also had been on this project then. He had come later to the Manhattan Project.

**Wilkins:**

I think I knew Buneman after the war. But what was he doing in Cambridge'

**Bohm:**

I don't know. Maybe he was working somewhere in there.

**Wilkins:**

I remember him vaguely.

**Bohm:**

Anyway, then I went back to Paris and finally went off to Israel. It became clear to me that the time wasn't right for going to Europe. It didn't really attract me to stay in France, and I didn't want to bother to learn the language. But also I mean Paris looked a bit grim at the time. I had this feeling it was too much just moving around, empty movements. You know, how people running around making loud noise.

**Wilkins:**

You mean French intellectuals sort of getting all caught up in this idea or that idea.

**Bohm:**

Yes.

**Wilkins:**

That was probably quite true, yes.

**Bohm:**

Is there anything else' On the other hand I didn't want to come back to Brazil. I felt it's life was hard then. You know, it was a case of the society was very poor.

## Interview Session - 6

**Bohm:**

Well, it has been several months since we discussed these things and it is not fresh in my mind, but I thought I would sum up a little bit on Brazil and try to get on through Israel and Bristol and what I am doing during that period. I think we have discussed that I came to Brazil in 1951. I think we discussed some of things that happened in Brazil. They took away my passport and I decided to stay there anyway. In the beginning, I was working with a few people and it looked as if maybe we could do something, but gradually, many of these people left, and also the general chaos in the department and university and in the whole area was such, that and also my difficulty with my digestion and was wearing me down. I found the climate too hot. All around, I began to think of leaving. Before that, I would like to sum up some of the things that I was doing there. When I first arrived, we discussed this causal interpretation of quantum mechanics with Tiomno. We developed an extension of this to spin.

And later a fellow called Shiller came from America. We got him here and I worked with him on this spin and on several other questions.

**Wilkins:**

Why did he come from America?

**Bohm:**

Because we invited him and he was interested, and we managed to get a fellowship to cover his costs. After about two years he left, of course. While he was there, that was somebody. And there was Walter Schitzer who was one of my assistants. We worked on probability, working out an idea about probability, which is really close to modern chaos theory, that is, there was always some doubt about the interpretation of probability. What does it mean? One idea is that it is a subjective estimate of likelihood that people say gamblers make.

**Wilkins:**

Gamblers?

**Bohm:**

If the coins are balanced you will estimate that they will be equally likely to come either way. The gambler used to form some notion of the odds before any theory existed and professional gamblers could get a feeling for what the odds were and could, therefore, work and win in the long run. I think it was Lapla who worked out the theory of that. That began the theory of probability. But that was on the basis of a subjective notion of probability.

**Wilkins:**

You mean Lapla did not put it on an objective...

**Bohm:**

No, he just put it on a mathematical basis, but he took their assumptions, still subjectively. Later, during the 19th and 20th Century, people began to try to put it on an objective basis and Famesis [?] tried to say probability was the relative frequency after an infinite number of events.

**Wilkins:**

You mean that Lapla did not go that far?

**Bohm:**

I do not think he did. I do not think that he tried to give a philosophical ethical basis for probability theory. He was merely interested in the calculus work, trying to deal with these odds as the gamblers used them. When they began to extend the thing to all sorts of statistics, then people began to feel the need for a more objective basis, like medical and social statistics.

This idea of relative frequency is also not terribly good; because it is not clear why this relative frequency does not exist in the individual thing. Now why a bunch of the examples should produce a certain relative frequency is not clear, and in fact it never is exactly right. There is no guarantee that if you have thrown the coin a hundred times and it has come close that half will remain close. The whole idea of a random distribution is that it can change and move away from the right probability for a certain period. The thing was not at all clear what probability meant.



Popperate [?] developed an idea of probability as a propensity or a tendency. For example, if you have a coin that is well balanced, the tendency is equal for heads and tails, but if you were to weight at the tendency would favor one or the other. It is a disposition he called it. I tried to give it an objective meaning, but again, it is not too clear. Probability was playing such a big part in physical theory, and yet it was not too clear what it really meant.

We thought of an idea, people have been thinking that when you have a sufficiently unstable motion, a small change of initial conditions producing a big change in the result. This favors a sort of a random kind of trajectory. You can imagine a lot of hard spherical balls colliding with each other, so a very slight shift in the initial position of one of these balls would greatly shift the angle of scattering. That would greatly shift the next particle and hit and so, so the whole thing was very sensitive to initial condition. Also, you need something, which we call a chaotic tendency in the motion, not to favor any one part in the long run and not to repeat sequences in a regular way. The idea is that certainly determinant laws, which have this unstable character, favor a kind of chaotic motion. We gave

some examples of that which worked out through the phase angle up to isolators whose periods were not commensurable. You can show the phase angle jumps all over the place and fills up the space. More, or less uniformly in the long run.

**Wilkins:**

When you say that it is all over the place, it did not really when you look into it precisely...

**Bohm:**

That is always true in each case and every probabilistic experiment, too. It sort of explains why in the long run on the average you tend to get a certain result. We were proposing that this chaotic notion could be an explanation of probability. Since that time, this chaos theory has more recently been developed in many ways quite a bit further along those lines and a little more precisely. That was one of the lines of work I did with Walter Schitzer which we published in [inaudible]. The thing with Shiller was the causal interpretation of the quantum theory.

Then there was Mario Schoenberg, who came back from Belgium while I was there. He had been a

professor. He had left because he had been in trouble with the Brazilian authorities. He had been in jail for a short period. He left and worked in Belgium for a while, but then he came back while I was there. We discussed a lot of physics and philosophy. He was, of course, a Marxist communist really, at that time. I do not know what he is now. We discussed, I had been very interested also, when I left America, going into the philosophical notions around causality because the quantum theory had raised that issue and I had proposed the causal interpretation. I wanted to understand better what causality is. I began to write sort of a series of essays on it, just for my own purposes. I gave a copy to Mario Schoenberg. Essentially, his criticism was too one-sided. It was taking causality and ignoring chance. The two were so inseparably related that you could not discuss one with discussing the other.

**Wilkins:**

You mean that is kind of complementary...

**Bohm:**

Dialectical relation. He would not have used the word “complementary.” You can use it if you like. But I mean the ideas?

**Wilkins:**

Same idea?

**Bohm:**

It was similar. I am not sure. If you take complementary in Bohr’s sense, it was not same. Since the word is somewhat ambiguous, it would better to say a unity of opposites. The idea is that these were inseparably united. Essentially he said that if you take and generalize to necessity and contingency, necessity is what cannot be otherwise and contingency is what can be otherwise. These are too opposite. They are clearly opposites, because you just put the word not to distinguish one from the other. The notion now is that absolute necessity would say — you know, justice on the side of necessity and no contingency, or absolute contingency, if we could ever imagine it, would be to say there was no necessity, no rule whatsoever.

Both of those extremes are impossible in a dialectical view. The point is that every necessity takes place in a context of contingency. It depends on all sorts of conditions and factors that are beyond or outside that context and therefore, its necessity is limited by contingency. The word contingency is essentially touched together. You know what touched together means? It is touched by something. If it is independent, it remains necessary, but as soon as it is touched by something beyond, it is contingent. On the other hand, necessity is limited by contingency and necessity is relative. But then yet contingency is not separable from necessity. First of all, in the theory of probability, the law of large numbers says that the average behavior of a large number of contingent events has a certain necessary average in the long run. Therefore, contingency gives rise to necessity. It becomes necessity.

**Wilkins:**

Yes, the whole concept of a long run or something like that.

**Bohm:**

Well, even if we are admitting that it is a bit vague, but still if you admit it.

**Wilkins:**

That is the general idea.

**Bohm:**

A great many of our physical laws are of that nature. If we accept quantum mechanics to the present view, all of them are, in fact. Therefore, all necessity seems to rise out of contingency. But on the other hand, that seems one-sided. Does not contingency arise out necessity? That was the work I did with Walter Schitzer to show how something like chance could arise out of — close to chaos could arise out a necessity. Therefore, necessity can be contingency and contingency becomes necessity. Each one reflects the other and ultimately, in the totality, they are identical. They are just two sides of one process.

That led me to the idea of the infinity of levels, to say that every necessity is limited by a contingency, which is in turn a necessity in a broader context, which in turn as a contingency. Every law is an

abstraction of some relatively independent domain of necessity. It is in the context of some contingency. Every law involves necessity and contingency. Classical physics is that way. The laws of motion are necessary, but the initial conditions are contingent. No laws exists which does not unite both. I included this in my essays, and then I sent these essays when they were finished, I also included a causal interpretation of quantum mechanics, and the idea led me to the qualitative infinity of nature, to say that nature is infinite and we abstract some domain of necessity and contingency, which we may extend, but we will always find, however, for it goes that there is some context from which we have abstracted. Therefore, I said that the nature is qualitatively infinite, not just quantitatively in this dialectical way. I sent these essays to Eric Burrup and he apparently transmitted them to Newman Franklin and they suggested I could put them in a book, so I organized them, finally, into a book which they accepted, which is *Causality and Chance in Modern Physics*. That was published in 1957 by Rutledge. That was one of the key ideas that developed while I was in Brazil was this infinity of nature.

I think that it had already been implicit in some of my feelings before that in America, which we discussed. One was that science fiction story that I had told you which was about the beings that came from this planet being civilized for millions of years. One of the features of the beings was that they gave some of their science to beings. Remember some of them saw tremendous power in it and wanted to use it for power, and then they tried to bring in this scientist, remember? He was considering this plot, but then he could see that nature is all infinite and interwoven, and therefore it makes no sense to take power. It is really basic, but not only infinite, you cannot take power, but also you are not separate from that which you want to take power. You whole being is the same fundamentally. Therefore, I had that view in 1950 that there was infinity of nature. And I remember seeing there was a film made in Czechoslovakia just before the Russians went in there, which was The Emperors Nightingale. I cannot remember the details. It was about a mechanical nightingale the emperor had. One of the images I saw in there was sort of water in which they made sort of a little disturbance of a wave. It got the idea of an infinite depth to the water, some



infinite subtlety of movement. That notion had been there to say that matter was infinite inwardly. That was what I was trying to say in the book. I think that notion has sort of stayed with me since then.

**Wilkins:**

Are you arguing then about the power that somehow there is — are you suggesting that some fundamental irrationality in the whole idea of power?

**Bohm:**

No. I am saying that merely to try to take power over something else just for the sake of power is meaningless, because it is not that it is irrational, your view of it is irrational if you think the thing over which you are taking power is different from you. Because of this infinite depth, we are all going to have the same ground and you will find that as you try to take power, you are controlled by what you are trying to control.

**Wilkins:**

You mean that it is the attitude towards your power, which is irrational?

**Bohm:**

Yes. The power itself may be useful, but you are trying to use power as a supreme value and the real reason for being, rather than some purpose, some good purpose. If you say power is to gratify the ego, then it is destructive.

**Wilkins:**

You mean if your own power that you are using —

**Bohm:**

Or your country or whatever. In that case, the power of the human race. It does not matter. The power of some particular segment is taken as the supreme value.

**Wilkins:**

What you say is that if you use power in the sense that you are kind of plugging into the power of the whole sort of universe, which makes sense?

**Bohm:**

Its makes sense, but you must understand the nature of the universe to be able to do that. It is all

interrelated in one and opposites are united and so on.

**Wilkins:**

This is like all these environmental ecological notions, they sort of work with nature.

**Bohm:**

That is right, because, ultimately, if you ignore the nature of which you try to control is the very basis of yourself. If you do not do it right, then you yourself will go.

**Wilkins:**

Actually, I would like to ask you whether you have read anything on this Gaia Hypothesis.

**Bohm:**

I read a bit about it, not detailed.

**Wilkins:**

I do not want to get onto this off the point, but I want to go and look at it a bit more, because the whole idea begins to attract me. Originally, when I first heard, I thought it was all a bit pithy. There was

something in The New Scientist about it the other day. Apparently the man, Lovelock, who is a [???] with the world society started it all. It was a serious science. Anyway, we will get back to get it. That is a similar sort of notion?

**Bohm:**

That is related, the idea. It was the idea that everything would be basically, deeply, internally related to everything through this infinite depth of the ground of matter from which it comes. I think that those are some of the ideas I worked on in Brazil. One point that struck me was that Schoenberg had said that Lenin had told the communist to study Hegel. Schonberg had done some study of Hegel. Very few others, only a few others, have done it. Perhaps they found it too hard, or too unattractive to them.

**Wilkins:**

You mean Hegel in general or Hegel on...

**Bohm:**

On logic especially. But I mean Hegel in general, but especially his logic.

**Wilkins:**

I think that Hegel on the science presumably is very difficult because the science was also up the creek.

**Bohm:**

Yes, but that is only a side issue. The details of the science change anyway. Almost anybody in the science of that time would have been very limited in value. The point is that the depth of his thought rather than the particular content.

**Wilkins:**

Yes, fundamental notions.

**Bohm:**

Yes. I remember also, before leaving the United States, I picked up something in the Princeton library, some Soviet publication which mentioned Lenin saying that the electron was inexhaustible. He had apparently done some work...Lenin had written an article on modern physics. He was interested in it. Apparently, he had some sense of things to say about it. One point he made was that the electron was inexhaustible. That sort of struck a chord

because I said, “Well, not only the electron, but everything, all matter is inexhaustible.” It seems that not a great many people took Lenin’s advice to study Hegel or to go into this inexhaustibility.

**Wilkins:**

No. And they would not be locking people up if they believed in a good thing.

**Bohm:**

I thought Schoenberg had a deeper view of these things than most of the left-wing people. In a way, he helped to show me that I had been approaching the thing in a narrow way, by just looking at causality, without bringing into the opposite side of chance.

**Wilkins:**

Oh, I see. You mean here is an example of Hegelian Marxist thinking? You mean being a stimulus to developing your ideas?

**Bohm:**

Yes. I was getting into sort a fixed channel by just looking by trying to analyze causality by itself.

**Wilkins:**

Yes. It is an interesting point, because it is really the whole question. Are Hegel's ideas of any use? Here is an example of where it was, apparently.

**Bohm:**

I think that people have not understood it sufficiently for us to answer the question. Very so few have understood it and it has not been put to test as to whether I am going to use it or not. There is no adequate way — the few people, who have understood it probably — you cannot really tell. But certainly Marx regarded Hegel's ideas as valuable, he just that he turned them upside down and Lenin thought they would be very worth studying, especially the logic. Certainly, these are two of the great leading lights of communism, so the testimony should carry some weight.

**Wilkins:**

Yes, but, of course, a lot of people would not take this view because they would say, "Where did it all end up with the right wingers who now say that any

form of state action necessarily leaves to authoritarian totalitarianism.”

**Bohm:**

That is not directly connected to what Hegel — You cannot look at Hegel that way, but you cannot necessarily say that anybody, even Hegel, was not entirely consistent and, so far he emphasized the universality of thought, but he said, “I remember reading that the person should regard the thought of his nation as the universal and the will of his nation as the will which overrides his own will, and the child must regard the will of the parents in that way.” I think Hegel was bit parochial at that point, because it led him to say the parish and state was the highest form of human achievement.

**Wilkins:**

I think I read something about that putting it in rather a different light. You know this whole sort of Prussian state being a kind of some final form of perfection. It is not really what he had in view. I suppose if you take this electron being inexhaustible notion, I suppose — I had said about Randall that he used his personal ambition as a vehicle for carrying



through his ambitions for programs for the general good. Assuming this is a kind of dialectical relationship between the personal ambition and the wider ambition of general ideas for science and education. And presumably to some extent, the two are never separable, are they?

**Bohm:**

No. The question is really, and we will have to discuss what is meant by personality that would lead us into a long discussion, whether the person — Perhaps when we get to Christian [???] that sort of question would come up more naturally.

**Wilkins:**

The real thing is whether you look at the person as some sort of isolated thing or whether you look at it as some kind of focus in the totality of the thing.

**Bohm:**

Yes. Do we look at the person correctly is the question. I think that Hegel was wrong in saying that the will of the nation was to be regarded it as the genuine universal and that you really had to submit your will to it under all circumstances. Because he

failed to see the concept of the basic unity as humanity and indeed the whole Earth, the Gaia Hypothesis.

**Wilkins:**

I think one would probably have to look in it. It sounds so bloody stupid that one feels that maybe people are somewhat misunderstood [inaudible].

**Bohm:**

I read it directly in his logic and I don't think I misunderstood it. I mean, it was part of his?

**Wilkins:**

You mean you think it was quite clear?

**Bohm:**

Yes.

**Wilkins:**

It had been translated hadn't it?

**Bohm:**

Well, but I don't see that that — It was difficult to translate that sort of idea.

**Wilkins:**

You think he was saying it to —

**Bohm:**

He repeats the idea in several places. He has the assumption that society is completely right and when the criminal is punished, and this is a sign of the inevitable rightness of things going on. He really felt society was right, the individual had to fit in. I think his mistake was to say that society was basically right and good, when it was really corrupt and destructive. I do not think that we have had a good society in recorded history that I know of. That is the basic mistake which many of these people make. If society were good, then it would be right to, for society would, generally speaking, take precedence. This society was basically criminal as it is in the case of nation's states, which plunder each other and kill and destroy. The wealth has come in that way. It does not make any sense.

**Wilkins:**

If he had some — by speaking of a Prussian state, he really meant something rather different from what people would normally, normal meaning of the term, Prussian state. If he meant some kind of general background of sort of common interest in social relationships.

**Bohm:**

He meant that the soldier had to follow exactly the orders. That was part of the whole thing. He believed in the military. He believed in the soldiers. He believed in the power of the state. He just simply swallowed all that stuff, which everybody swallowed in those days. Or most people.

**Wilkins:**

Maybe one just says that he was a man of his time and condition and he could not escape from this sort of?

**Bohm:**

He might have escaped, but he did not. Other people did. The Quakers did not accept all that, for example.

**Wilkins:**

That is another matter. It is all [???] the same, is it not, that a man with a mind like that should have, if he really did fall into that trap. It is odd, however.

**Bohm:**

I think that he was limited in many ways, but still there were certain points, a lot of things which are worth looking into in the nature of thought. I sort of got an interest in Hegel that way and later I pursued it.

**Wilkins:**

That is one of the important things about a man's idea and not things which were wrong, but which were right.

**Bohm:**

Well, both are important really. It is a matter of trying to evaluate the whole thing.

**Wilkins:**

They can be related, but ultimately, it is what you can make out of the things, which were?

**Bohm:**

For example, he regarded the Christian religion as the highest form of religion. He looked down on the Hindus and all that as rather primitive. On the other hand, he did not notice that the Christian religion was a religion of love, because, he says that you have to stick to your nation, the soldier has his duty to kill the other Christians, and so on, when he is told to. These inconsistencies were not seen by him as inconsistencies. But that was part of his age, which all the Christians believed that they were following the will of God as they slaughtered other Christians and non-Christians and so on.

**Wilkins:**

Except the minority, right?

**Bohm:**

Yes. He was not able to get out of the general spirit of the age, but he nevertheless had some valuable insights.

**Wilkins:**

It is the same with Freud and I think Darwin regarding women as being all sorts of inferior beings, and when you read these things that they said now it sounds as if they were some sort of anti-feminist monsters, which they were not.

**Bohm:**

No. They were just mouthing the things that everyone accepted. It is just that it is just one of the things that people do. What I learned from Christian [??] helps point to that and some of the things that can be done about it. This conditioning, also from Demarie's [?] ideas.

I do not know if we discussed it, but remember that I said that I decided to leave Brazil. I did not feel that I would be safe to go to the American Embassy and ask for a passport because the whole McCarthyism was going on and I did not know what to make of it.

I thought that instead, I would apply for Brazilian nationality, which I did. One was allowed to get it after three years if you were in the university teaching. I got this passport and I left. I had this offer from Israel. I knew David Fox, whom I had known in Berkeley. He was there in [??] He put me in touch with Nathan Rosen. There was also a fellow called, Quitcity [?], who had come independently to some power, and he had just gone ahead of me to Israel. He was not Jewish. He had come from Germany and he had some trouble with the American authorities. He told me that they wanted him to engage as an agent against the other side, and he did not want to do it. They began to make trouble for him. I do not know what the whole story is.

Anyway, I got this offer and I went to Haifa in March of 1955. In general, I was finding it hard to get on in Brazil for all these reasons, this chaos. I did not feel that it was a place that I — especially since all the people I knew whom I had worked with were gone. As a place to live, it was not attractive. There were so many problems there, so I thought that I would try Israel. In Israel we got started in a Technion there and we had a few friends there?



**Wilkins:**

Who was paying you?

**Bohm:**

In Israel?

**Wilkins:**

Yes.

**Bohm:**

The Technion.

**Wilkins:**

What is that?

**Bohm:**

That is the technical university it means.

**Wilkins:**

I see. You had a kind of official [???] post?

**Bohm:**

I came as a lecturer, but they raised it to an associate professor and then to professor. I just took any old

position to get there and did not want to waste time negotiating. In Israel I found, of course, it was the summer and the heat. It was much harder than in Brazil during the summer.

**Wilkins:**

You arrived in March?

**Bohm:**

It was all right in March, but by May it was getting pretty hot, and June — I had the same problems with food, almost the same. The salaries were extremely low. You had a few perks, but they got you an apartment for very cheap. Basically, I was using up more money than I was getting.

**Wilkins:**

What were you spending it on?

**Bohm:**

Just living.

**Wilkins:**

You are not the sort of person?

**Bohm:**

I mean just simply pay enough to, got reasonable food in restaurants. During the whole period there, it cost just a little bit more than I got. I met Sara there, almost a few weeks after arriving, at some sort of a party. Then I went to Europe that summer and I visited Jean Pierre Vigier. I did not mention to you that while I had been in Brazil, we managed to get this fellow Vigier invited. We also did some work on the quantum theory and the causal interpretation. He had been in deBroglie's group. He had written to me about some of my publications. Finally, we managed to get a grant for him to come for a few months.

**Wilkins:**

Was deBroglie in Paris?

**Bohm:**

Yes. So, we did a little bit of work, some work there and came out with a paper extending the causal interpretation to assume some sort of Brownian motion in addition to the regular trajectory due to a sub-quantum mechanical level that would give

further Brownian motion. It was sort of in line with this idea of contingency and necessity to say that instead of making it exactly causal, we left room for contingencies.

When I arrived, I went to Europe and visited Vigier in France. He was very active in the communist party there. In fact, I began to find difficulty with him, as he was so busy there, in the beginning, we had got together, but later he began to get so busy with their activities, that we did not really have enough time to work. Then I went to Israel, as I said. That summer, I went back to Europe and I visited Holland, France, and England. That's when I visited Vigier. I think we did another paper. In Israel, I did not do a — I cannot say that I did — I did a certain amount of work, but primarily it was a period when my ideas were developing. It was a bit hard to actually — the things were a bit hectic there, so it was a little hard to actually proceed with the kind of concentration on work that I had done before.

**Wilkins:**

What kind of things?

**Bohm:**

I do not know. I cannot quite explain it. Partly, it was a matter of the climate being hot at first. Then, I was a little bit unsure about my plans. What shall I do? I had an offer from DeBroglie to come to Paris and I was very unsure as to whether that would be a good thing. Price had made an offer to come for a year to Bristol. There was a professorship vacant and I could have come during that year. I did not know?

**Wilkins:**

You mean for one year?

**Bohm:**

I did not know whether that, he said it might open up to some more. I did not really know what to make of that. I liked Price when we were at Princeton. We got on quite well. I think I did visit him. Yes. No, I did not. I went through a period of wondering what to do. Let me think. It was very unclear, because I was not all that happy with Israel. It was unknown. The people who had come. There were two people, David Fox and Paul Zills [?], whom I was working with. From America they had come. They were

unhappy there at the Technion. They were thinking of going back.

**Wilkins:**

Why were they unhappy?

**Bohm:**

Because the Technion was such a mess, the organization. Everything they tried to do got into such a terrible mess. We came demoralized.

**Wilkins:**

What kind of mess?

**Bohm:**

Administratively. I cannot remember the details. It was sort of chaotic.

**Wilkins:**

Do mean that possible the whole of the Israeli society was somewhat disorganized?

**Bohm:**

It was not terribly well organized. All you can say is that the Arabs were far worse. That is the reason they won.

**Wilkins:**

They were a bit like the Arabs and soldiers.

**Bohm:**

Yes.

**Wilkins:**

Instead of being?

**Bohm:**

They were more European than the Arabs, but they were not terribly well organized. They were a bit corrupt, some of them.

**Wilkins:**

Kind of mucking about, as you might say tendency to.

**Bohm:**

Yes.

**Wilkins:**

This would be hectic, you mean, and make it difficult [inaudible].

**Bohm:**

Yes. You do not really know what you can count on and who was going to stay there. The climate was a bit against me.

**Wilkins:**

Unpredictability.

**Bohm:**

Yes. During that time, I got started working with — let me see, not quite yet. It was very unpredictable. Should I go to Europe? Should I go to England? Should I go to Paris? Should I stay there? Meanwhile, Sara and I got married in March and it took some readjustment.



**Wilkins:**

Which March. Was that a year later?

**Bohm:**

Yes. That is right. I was not at all sure that I really wanted to stay in Israel, so we went off to Europe that summer. While we were there, there had been all sorts of rumblings about the disclosures that were coming out of Russia about how bad things were there.

**Wilkins:**

Which year was that?

**Bohm:**

1955.

**Wilkins:**

Stalin had gone. Had he not?

**Bohm:**

No, but then there were all these people following and it was beginning to come out, what he had done.

**Wilkins:**

Khrushchev

**Bohm:**

He was not in there, yet. Khrushchev came out just while we were in Europe in 1956, just after getting married. Khrushchev came out with the 20th Congress.

**Wilkins:**

You mean the disclosures about Stalin were several years after he died?

**Bohm:**

Yes, because a whole bunch of people came in between.

**Wilkins:**

I had not realized that.

**Bohm:**

They were not able to manage it.

**Wilkins:**

I can remember one day — Stalin died in March, 1953, which was when the DNA Double helix. I remember it that way.

**Bohm:**

Then, there were a series of people who came in and they were thrown out. They were going through some mess.

**Wilkins:**

All this great exposure of Stalin was about two years later?

**Bohm:**

Yes. It was beginning to come out before. People were talking about it in bits, but one did not realize how far it went, but then suddenly it all came out. This was a tremendous shock to me. I had always hoped that socialism would be a way to approach these problems that humanity was unable to solve.

**Wilkins:**

Yes, but you mean that until the Khrushchev type of revelations came out about Stalin, that you have been somehow able to not pay attention to the things that people had been saying.

**Bohm:**

I knew. I paid some attention to them. But first of all, it was said that maybe they were exaggerating. Maybe some of them were lying.

**Wilkins:**

You were still uncertain as to what the significance was?

**Bohm:**

Yes. I said, “Well, maybe socialism is the way, but it was beginning to look more dubious.” But then the revelations of Khrushchev that it came clear that they were really in a mess beyond imagination. I mean far worse than czarism or anything.

**Wilkins:**

I knew they were worse, but after that [inaudible].

**Bohm:**

Well, they killed millions of people.

**Wilkins:**

The czars killed many, many people.

**Bohm:**

No, not millions. The czars were unable to do what the communists could do. Let us take Lenin as an example. Lenin was sent into exile to Siberia with his books and his wife. These people are sent to gulags where they are starved to death and beaten up and come to the very edge of dying, like this woman who just came out. They are kept frozen and unfed. I think they are doing it far more systematically and far more pervasively.

**Wilkins:**

That may be right.

**Bohm:**

And also far more ruthlessly. They justify themselves far more. That was an interesting thing. About ten years after that, I talked to Vigier and he said that he did not think the revolution was of any great value. He thought that it did not even produce a higher material standard, because he thought that without the revolution, they would have got it anyway, like the Koreans. They could have gotten what they got materially without all this tremendous upheaval.

**Wilkins:**

Speculation.

**Bohm:**

Speculation, but probably they could. They had enough invested.

**Wilkins:**

Yes.

**Bohm:**

Because they have not produced magnificent results from the point of view of standard of living.

Anyway, it was a very big shock. I was in Paris at the time. Sara had just gone to England and I was sort of alone there. I remember walking around?

**Wilkins:**

Did she have relatives in England?

**Bohm:**

Yes, she had relatives. I remember walking around Paris for hours on end. Finally, I went to England to meet up with Sara. What did we do then? Perhaps we did go to Bristol to have a bit of talk with Price. No, we did not. I looked around to a few people to see if there were some jobs. Some people at King's College. I think I told you. One of the fellows was called, Wolfarth in the physics department. He had been working on plasma. I talked with a few people, but it did not look as if there was much available around. I do not think Eric was very encouraging. Then came the thing that came this, Suez while we were still in Europe. The Suez invasion with Israel, France, and England.

**Wilkins:**

Which year was that?

**Bohm:**

1956. It was a big puzzle. I was really disturbed. Should we go back to Israel or shall we stay here? Finally, I began to see that the thing was getting settled, so we decided to go back to Israel, just about. It was clear that they had pulled back from this more, so we went back to Israel. This whole thing had been a tremendous strain that summer. In this atmosphere, which had been building up all around, it was hard really to ??? nation in one direction and the second photon perpendicular. So one model would be that the two photons were correlated, but their directions of polarization were distributed at random. We distinguished that model from what the quantum mechanics predicts and the quantum mechanics have that much higher correlation than that model would give. We therefore said that this already was a strong indication that you could not explain these results by that sort of simple model, but that quantum mechanics had something more in it.



**Wilkins:**

How were the photons being produced?

**Bohm:**

By the decay of positronium [?]. The annihilation of the positron electron pair to produce a pair of photons of opposite polarization.

**Wilkins:**

You mean mass was going into energy?

**Bohm:**

Yes. That is right, but in this process, each photon would, if one were polarized in one way, the other would be right angles. We said the simplest model would be that one be polarized this way and the other that way, but let the direction itself be distributed at random. We show that that produced considerably smaller correlation than the quantum mechanics predicted, and that the experimental results were in agreement with what the quantum mechanics predicted.

**Wilkins:**

Experimental results were being?

**Bohm:**

Yes, in agreement with quantum mechanics and therefore against the simple classical model. So we show that this is the first time we had said this was not a hypothetical experiment, but there had been an experiment.

**Wilkins:**

You mean people have not noticed the significance of those results?

**Bohm:**

Yes. I do not know if I published any other papers, then during that period. I became interested in Hegel and read so; I began to read his logic. I felt that there must be something in there. I read it again and again. At the beginning, we just picked up little bits of it. Then I met this fellow, Michelon Roe, who had worked for the kibbutz movement there. He was teaching philosophy there. He was the left wing kibbutz movement, it was called Isuhmer Hatsieer

[?]. They had the kibbutz seminar in Tel Aviv. He held several seminars there every few weeks. I went down to Tel Aviv. He discussed his ideas in dialectic about the universal and the particular, and so I knew him. His basic contradiction he considered was between the universal and the particular. I gave some talk and later, and when we visited Jerusalem I went to see him with Sara. I spent a whole day talking Hegel with him. He did not speak much English, but he was primarily German speaking and he spoke Hebrew and Sara spoke Hebrew, so she did some translating between his Hebrew and English. I could pick up some German. He did a little bit of German. I found that he had a great deal of insight into Hegel, he had thought about it a great deal. He felt it would be very, this particular part, what is called the theory of essence, especially the theory of actuality, would be very significant for science and for physics. Therefore, we talked over that part a great deal. It sort of set me going more intensively. It is very hard to explain, because you have Hegel as one system and you cannot really — Essentially, it is important to say that Hegel was dealing with the properties of thought, but thought considered as an actual process to which you would pay attention.

You see, not just the content of thought, but the process of thought. So in a way, Hegel was considering thought as a real process to which you would pay attention.

**Wilkins:**

You mean that he was talking about the way in which thought moves?

**Bohm:**

It moves, yes. It moves through its contradictions. Thought is essentially movement. It is only a limiting — thought which holds still, apparently still, is only a limiting case which holds only a little while. Thought cannot hold still; it has to be in movement.

**Wilkins:**

I think this whole idea is foreign to most Western thinking, is it not? That people think about facts and thoughts as being sort of isolated things which [inaudible].

**Bohm:**

What he thinks of as a process, which one becomes the other. First of all, the opposite one becomes the opposite, then the opposites reflect each other. That is the theory of essence. And the theory of the notion of the idea of the opposites are each other.

**Wilkins:**

You mean the movement of the thought sort of this corresponds to the sort of the struggle of the Marxist?

**Bohm:**

Yes. He does not take it as a struggle. I think Marx brought that in. It is a kind of movement that develops that when you pursue this thought to its limit, it turns into its opposite as part of its movement.

**Wilkins:**

That is quite true, but there has got to be something keeping it moving, is there not?

**Bohm:**

The movement is the move to understand.

**Wilkins:**

Okay, but there is some sort of motivation, there is some sort of energy there all the time.

**Bohm:**

Yes. That is right.

**Wilkins:**

The thing is sort of alive, so to speak, floating about.

**Bohm:**

Yes, it is moving to understand.

**Wilkins:**

It has activity.

**Bohm:**

It has got activity. We do not necessarily emphasize the idea of struggle of one side trying to stop the other.

## **Wilkins:**

No, struggle as a particular form of activity, is it not, pushing against something.

## **Bohm:**

I mean overcoming resistance and so on. The first part of Hegel was the theory of the immediate being, which begins with being and becoming. It goes on to quality and quantity. The union of quality and quantity, as he calls it “essence”. It feeds onto essence. He shows how quality becomes quantity, then quantity becomes quality at a higher level and as the change of quantity leads to another quality, and on and on. What remains constant in this continual change? In this continual change, there is a deeper level remaining constant, which we call, essence. Therefore, this change is kind of appearance. It is at least something not a — So, you come to the idea of essence, which is the idea of two levels of being, the true being and the superficial being, the show. The basic property of essence is to be able to show and to have a show or a seeming or an appearance. Without appearance, essence is pointless. Essence, which never appears would not?

**Wilkins:**

You mean it is the only way of getting a view of the essence? You mean it is the [???

**Bohm:**

Not only that, but it is one of its major functions to produce appearance in thought. We are not thinking of the reality or anything like that. We are thinking of the way thought works. The essence of essence is to shine as appearance. In other words, it is the one essence behind a range of appearance, constant show of appearance.

**Wilkins:**

I think I see what that means.

**Bohm:**

Therefore, the qualities of essence and appearance are correlative qualities which require each other. But ultimately, if you follow it through, through actuality and causality, the inner and the outer, you will find that essence is itself a kind of appearance. In fact, the movement between essence and appearance is an appearance, which is in an



immediate actuality. This leads on to the idea of the idea, the notion, which is a self-determined idea. In essence, the opposites stand against each other. There are three levels. In being, when the opposites become each other, they turn into each other by movement. In essence, they are stabilized and stand against each other in relation. In the idea of the notion, they unfold and they are each other. Each opposite is merely the unfoldment of the other. He used the word, it was translated as development, but in several places, the word, unfoldment, is used. One will have to check the translation. In the sphere of the idea, movement is unfoldment, and that is where the universal unfolds into the particular. It took me a very long to realize it. One's habit is to always say these thoughts are thinking about real things. But it was very important to understand Hegel to say that he was not thinking about any real things, primarily, he was thinking about thought. That is a real thing, but is a peculiar kind of real thing.

**Wilkins:**

You mean because of all this materialist thinking that one was —

**Bohm:**

Yes, that is right, but even if you say that thought is a material process, we could say that it a subtle material process and Hegel was thinking about that.

**Wilkins:**

I see. You would put it in those terms.

**Bohm:**

Yes, if you want to be a materialist. If you do not, we will put it in Hegel's term, which is that thought is the primary reality, and that matter itself is like the thought of God. Matter itself is the symbol of God's thought. Not God, we want to say the universal thought or whatever you would like. It took me many years to get that point, because the whole tendency as a scientist is to see it the other way.

**Wilkins:**

You mean that this is an illustration of how difficult it is to get out of a very highly ingrained type of thought process?

**Bohm:**

Yes. One could say. I realized by the time that I got to Israel, I began even in Brazil, but by the time I got to Israel I realized it was very important to understand thought because everything depended on thought. If our thoughts were not straight, the whole thing would go wrong. Everything we did depended on thought. Therefore, I said that it was very important to understand thought above all, and it was one of the ideas that came to fruition in Israel.

**Wilkins:**

What about this whole business of saying that thought in any case cannot be isolated, because it is only, it has a complementary relationship to say, feeling?

**Bohm:**

Thought includes feeling. The same way with Descartes, Hegel gives various quotes from Descartes. He said, “I think, therefore I am.” Descartes included all sorts of thing in thought, including feeling. In fact, he meant consciousness.

**Wilkins:**

I see. So, he is using it in a more general sense.

**Bohm:**

Yes. If you say it — if we would put it that we do not understand consciousness, the whole thing would go wrong, because if our consciousness is working wrongly, everything else will work wrongly.

**Wilkins:**

I see. So, it is not thought [inaudible].

**Bohm:**

No, but Hegel himself says Descartes meant consciousness when he said, “I think, therefore I am.” He could have said, I am consciousness, therefore I am, then would have understood it.

**Wilkins:**

If he had said [???] I am conscious?

**Bohm:**

No. It would have been clearer, because? He did not mean it as a syllogism. He quotes Descartes to say that therefore, I did not mean it was a prove. It was merely a way of saying that was the essential quality of the self.

**Wilkins:**

You say that what Descartes meant is made more clear by saying, I am conscious, therefore I am?

**Bohm:**

Yes. My essential quality?

**Wilkins:**

I was always puzzled by this Descartes thing, about, Thinking, therefore I am. You think that is what Descartes really meant?

**Bohm:**

He quotes Descartes, saying that Descartes really meant consciousness.

**Wilkins:**

You think that if you look up what Descartes said, you mean you think that it has been wrongly presented?

**Bohm:**

They use the word “thought”, but he meant by the word thought, consciousness.

**Wilkins:**

Yes.

**Bohm:**

Krishnamurti does the same.

**Wilkins:**

I see. It depends, you mean, what meaning you are attach to the word.

**Bohm:**

If you say the whole of consciousness? I am saying that we have got to understand consciousness as a whole. Everything is within consciousness.

**Wilkins:**

I was not aware of that about Descartes. I had never sort of heard? I thought it was some kind of naïve?

**Bohm:**

Intellectualism, or something.

**Wilkins:**

Yes. Quite. It did seem a bit odd.

**Bohm:**

I was feeling that — I called it thought, but I meant by it all the other stuff. I was using Hegel as a language. I sort of absorbed Hagel's language. I became interested, for many years I used to reread Hagel's logic again and again, during the whole ten or fifteen years. Sara used to ask me, "What in the world are you doing reading that again and again? Have you not finished with it?"

**Wilkins:**

It is a bit appalling when you think of what happens to university students who are supposed to go to a lecture and then sort of have learned something. I

suppose what they are normally doing is just sort of their trivial rearrangements of previous ideas, is it not?

**Bohm:**

I was also developing along the sort of a kind of intuition for the mathematics, developing a kind of unified cosmology. I cannot describe it exactly and I have seen it all as a whole, understanding the role of mathematics. I used to talk to Sarah about a bit, about the conical transformations about one thing turning into another but remaining invariant.

Eventually she made a piece of sculpture on that basis of some sort of a surface that is turned around. She made it in clay, plastipreen, or was it, it was clay really. She had baked it. It was quite a ??? I used to be fascinated by the idea of the constant transformation from one thing to another, while remaining invariant in some deeper sense. I think that was part of the dialectic, too, to say that the dialectic between the variation and the invariant.

**Wilkins:**

Presumably, the whole notion of dialectic, you mean, there is not a — I mean one is saying that he



is a type of process, is not one So, that is saying something is not [??]

## **Bohm:**

In this process of change, there is the invariant, but then the invariant varies in a broader context, then you have to have a new process, a bigger process. There is no limit. The law is the invariant. This is an infinite law. The variation of the form and the invariant — you take an object and turn it around and go around it, it always looks different, but you have the idea of the invariant shape of the object. Then later on, the object varies if something is done to it. That may follow the law which is invariant, but then eventually even that law will vary. It is the same as causality [?] and contingency, that at every stage we have got both the variant and the invariant. It is not possible to have any stage of thought without the variant and the invariant, but what was invariant will be variant and what was variant will be invariant, as we change the context. That was an idea of an infinite law.

I was sort of developing those ideas of an infinite cosmology and infinite laws, trying to get a feel for

it during that period in Israel. I did not feel that Israel was the place for me. These people left, the people I knew, and I felt rather isolated at the Technion. I did not really want to work at Weizmann Institute. Somehow, it did not attract me, nor did the people of Jerusalem. I thought that maybe I had better try to get to England, to Europe. Finally, I decided that Price's offer? I missed that professorship, but he offered some sort of research associateship for five years. I thought I would try it. In 1957, we came to England and went to Bristol in the fall of 1957. On the way there, I stopped in Copenhagen in the Niels Bohr Institute.

**Wilkins:**

Had Bohr died by then?

**Bohm:**

No. He was still alive and I had a talk with him.

**Wilkins:**

He died soon after that?

**Bohm:**

No. It was about ten years after that.

**Wilkins:**

Ten years?

**Bohm:**

We had a talk together. We went to his house. I tried to discuss my cosmology with him, to try to understand the quantum mechanics more deeply, this dialectical cosmology, this dynamic cosmology. He did not really quite appreciate it. He said the ideas are beautiful, but they were on the wrong track. We tried to talk. He always stuck to his presentation. It was often hard to really talk seriously with him. It was not very clear, how he talked. He sort of, I think he often tried to throw the discussion off the track. He would start to smoke his pipe and light it, then he dropped a box of matches and spent a long time picking them up, and get his pipe lighted again. By that time, we had sort of forgotten where we were. I think he had methods for getting the discussion off a certain track onto his track. He was very friendly.

**Wilkins:**

Being friendly is no bloody use if you are not able to discuss what you want to discuss with him.

**Bohm:**

He did not take it very seriously.

**Wilkins:**

I wondered to what extent Bohr really was very open minded in discussion. There was the case of when he drove Heisenberg almost mad and Heisenberg had to go off and go skiing. He felt he was going out of his mind if he had [inaudible].

**Bohm:**

I think Bohr was very insistent, and he could, he stuck to it. He was probably passionately convinced that he was right and it was very important?

**Wilkins:**

Yes, but I think, I wonder whether he really listened to the other people enough?

**Bohm:**

When they were not on the lines he wanted, I do not think he listened.

**Wilkins:**

Why do I suppose that it is very difficult for people to listen to something which they [??] That is partly the whole trouble with the world, is it not?

**Bohm:**

I remember, just before leaving Copenhagen, I got an idea which was about the infinity. I thought of a tremendous number of highly silvered spherical mirrors reflecting each other. You had an infinity of reflections because each one would reflect on the other and the reflections would reflect. One could say that every atom was reflecting everything in that way, so that the infinity of everything was being reflected by each thing.

**Wilkins:**

You mean every particular thing was a reflection of the whole?

**Bohm:**

Yes. An infinite reflection of the whole, because it was a reflection of a reflection, and so on.

**Wilkins:**

I do not understand this thing about Bohr. What was it precisely about Bohr that enabled him to have this enormous influence on everybody?

**Bohm:**

I think that he had such an intense conviction of his rightness.

**Wilkins:**

Presumably, he must have been right, sufficiently at least, otherwise people would just get fed up with him.

**Bohm:**

He had been right, obviously, in a great many things. Most people were not very strong on philosophy anyway, so they did not want to argue. It was very hard to argue with him. Not only was he very insistent, but he is very subtle and very difficult to follow. I think that at some stage, most people gave up and said, "We cannot argue with you, it is too difficult."

**Wilkins:**

People could not have been all going to this laboratory and these meetings and all these discussions unless they got a lot out of it.

**Bohm:**

I think he was very inspiring.

**Wilkins:**

What was the form of his inspiration?

**Bohm:**

He was very interested in certain questions, which would fit in with his approach. He would be very avid to accept suggestions of all kinds, but as long as that was sort of not challenging his central approach.

**Wilkins:**

You mean that the other scientists who went there, their interests had enough frequently fitted sort of attempted to gear to?

**Bohm:**

They were more detailed. Their interests were in more of some details of mathematics or technical details or experiments. He could fit that into his general philosophy. He was very free in accepting these people's ideas and encouraging them.

**Wilkins:**

You think he did have an exceptional ability for sorting these sorts of problems out that the people brought?

**Bohm:**

Yes, he could sort of sort them out, encourage them, and see their points and point out things. He was very open to those things as long as his central position was clear.

**Wilkins:**

So it was this exceptional ability to listen and to make suggestions to other people.



**Bohm:**

Also, to adopt their ideas with real enthusiasm.  
When it came to the central thing, he could not shift.  
That is not uncommon.

**Wilkins:**

You mean that was like the Einstein relationship?

**Bohm:**

Yes, that is right. Also, with Heisenberg, he was sort of hitting hard on that central? That central core of philosophical ideas which touches a person deeply. I do not think Heisenberg ever fully accepted Bohr. He went along with him, but he came out with an approach which was sort of subtly different. He retained his essential philosophy.

**Wilkins:**

I suppose this would fit in with this story about what Bohr said about his wife, about how they had the argument about what sort of peram to buy for their baby.

**Bohm:**

What was it?

**Wilkins:**

They argued and argued for hours, apparently, about which brand perambulator to buy. Finally, the wife agreed with Bohrs' idea about the right sort of peram, and then Bohr was not content with this. He was really very disappointed that although she had adopted his position, that she had not really apparently adopted it for the right reasons, which were his. He still was not content. I think when I told Pat this, he thought Bohr must have been a bit of a monster.

**Bohm:**

I do not know.

**Wilkins:**

Suppose he was magnificent, within certain limits. It is like the scientist who is open-minded within the limits of the paradigm, but not outside. This is a general I suppose characteristic of all human beings,

that they operate in one way up to a point, and then the whole thing can change.

**Bohm:**

At some point, come the key ideas, the key assumptions which a person defends. It ceases to be open. Let's take the case of a religious person of good will. He is going to be very open and friendly to people, helpful and charitable and so on. But until his basic religious assumptions are questions, then he can become quite difficult.

**Wilkins:**

The same in free speech. They say in the universities, we must have free speech on everything, but then they say that someone wants to speak against free speech, they say no, we will not have that. They are always setting limits to what free speech should be. Are they not?

**Bohm:**

That brings us to Bristol. Bristol was also a difficult period, although we did get some things done there.

**Wilkins:**

What was difficult about it?

**Bohm:**

When I got there? First of all, there was a tremendous status consciousness there. When Price was in America, he seemed very open and very democratic or whatever you want to say, but in Bristol he was very conscious of his status as head of the department. There was a sense of hierarchy which showed in subtle ways of difference and all that. If somebody at work, people sat at seminars? The teas [?] had a very stilted constrained atmosphere. It did not have that sort of feeling? I felt that it was more so than other places, I think.

**Wilkins:**

Do you mean that people felt that they had to be minding what they said to make sure that Price was happy about they said?

**Bohm:**

Not only Price, but each other. There was a sort of general sense of people watching each other. I had a feeling.

**Wilkins:**

Not just him, but you mean everybody.

**Bohm:**

No, I would not say that it was everybody who did it, but a lot of people did it. There were a few I think who did not.

**Wilkins:**

That is rather unpleasant, is it not?

**Bohm:**

I think Sara found that in the sense that there was a lot of gossip about people in the community there, in the university. They were watching each other.

There was not an easy — See, we found it, first of all, very hard to find reasonable accommodations with the money we had. One of the things typical about Price was that he could have offered me the

job at the highest scale, but somehow he did not. He offered it lower. He had certain discretion for this job, a range of scales. Somehow, perhaps it was his own personal thing, but I think it was all the general atmosphere, all these things went together. People who came to visit, one of my students who came to visit me said the he thought Price was jealous.

**Wilkins:**

Jealous of you?

**Bohm:**

Yes, that it what he said.

**Wilkins:**

I think that? And, you think that possibly the other people also may have picked up some of his [inaudible].

**Bohm:**

They could have picked up these cues. Some of the others were not and I talked quite freely with them. There was a sort of atmosphere around, which was a little bit constrained.

**Wilkins:**

People used to say that Bernal was vain and was always careful to never have any people in his laboratory that might challenge his position as being the brightest person. Have you heard that?

**Bohm:**

No. I have not heard that, but it could be true.

**Wilkins:**

I think it probably is true. It fits the facts quite a bit. It does not mean that he was not an extraordinarily able man. Interesting.

**Bohm:**

Somehow, the atmosphere, there was strain on me, as well as on Sara. We also had trouble getting housing and we finally? Price had to move out of his flat, which was upstairs in some house, because his aunt had a heart problem, so we took that flat. It was very unpleasant because there was a landlady downstairs and we had to go up the stairs. She was sort of a bit difficult. She was a very narrow person.

**Wilkins:**

How had Price managed that?

**Bohm:**

He did not mind it, apparently. He got along somehow. For example, she? I cannot remember her attitude too foreigners, but she regarded me as a foreigner, and she told Sara that. Sara said, “Well, he comes from America.” She said, “But his is not really American, is he?” She said, “He was born there.” She says, “No, he is not.” She was saying that only the English settlers were Americans, apparently. What Sara said was, “Well, do you mean the American Indians were the real natives?” She had been a Protestant, she had married a man in Catholic Ireland and she had a terrible time. She hated Catholics. She was suspicious of all foreigners, but Catholics a bit more. We did get along, but she was sort of always upstairs there. It was not a good situation to have a landlady downstairs who was sort of very fussy. Rather not a person you really want to be close to.



**Wilkins:**

You did not have anything to do with Pauli.

**Bohm:**

I had talked with him, but I had no close relation to him.

**Wilkins:**

You mean his interest did not really?

**Bohm:**

No.

**Wilkins:**

He did not have sort of philosophical interests.

**Bohm:**

He had a little bit, but not very strong. There was a man called Stephen Curner, who was in the philosophy department and I talked with him a lot. Paul Feyerabend was there for a while; I used to talk with him about philosophy.

**Wilkins:**

What was he like?

**Bohm:**

Very interesting and quite lively. I think that Price has a mean streak of some kind. Also, there was this fellow, Aharonov, who worked with me. He did a paper with me on this line of flux in a magnetic — the interference of electrons effected by a line of flux if they do not touch. You understand? It was a new effect which first surprised people. Many people would not believe it existed. In fact, for ten or twenty years, people were still not believing it existed, though you had experiments. Somehow Aharonov found out later that Price had given him a poor recommendation for some reason, though he should have got a very good one.

**Wilkins:**

Why was that?

**Bohm:**

I do not know. I think that somehow Aharonov said something that offended Price.

**Wilkins:**

You mean that Price may have felt that he had been taken down a peg?

**Bohm:**

Yes. It did not do any good to do that because he felt that it was too much.

**Wilkins:**

I think if people feel they are not appreciated, some people can get enormous resentment.

**Bohm:**

When I visited him later, after I got this job in Bizkbeck, he was very much more at ease. I think that he felt uneasy about me being there. What I did was I did this work with Aharonov and then with Carmi we worked further on the plasma. I think Carmi did some good papers, but they were not appreciated by the physicists. They were highly mathematical, but still I think that most physicists did not quite see the point, which was this relationship between the individual and the collective, that we discussed before, to separate

them. There was a subtle somewhat philosophical point, which did not really catch their attention.

**Wilkins:**

I think, as you said, that scientist are generally less interested in calculating how things will behave, lot of engineers.

**Bohm:**

During that period, I went to a conference, I was invited. There had been my, a former student, David Pines, who meanwhile had become very well known in the field on the basis of this work we had done together.

**Wilkins:**

Where was he working?

**Bohm:**

He was in Illinois. He was now very well-known and he had gotten me invited to a conference. I think he talked in terms, it sort of got around that he was the one that did most of the talking, as if it was mostly his work.

**Wilkins:**

You mean things that you had put him up to?

**Bohm:**

Yes.

**Wilkins:**

Or, had done with him?

**Bohm:**

Yes. He sort of felt a little bit guilty. He gave a talk. While he was talking, he sort of gave a talk allotting all my work. I began to feel uneasy about that, why he felt it was necessary. That conference sort of disillusioned me. I could see?

**Wilkins:**

Nothing did go down into print, did it?

**Bohm:**

No.

**Wilkins:**

It did not cost him anything, so to speak.

## **Bohm:**

No, but I meant the whole conference; I could see the very shallow nature of these people. They were really watching each other all the time. First of all, I tried to talk about deeper issues of collective and individual and understanding it physically and there was no interest in it whatsoever. I could see that what they wanted to do was to put formulae on the board and talk about them and hope to predict an experiment. That was all. I could see that there was no way of communicating this deeper thing with them.

Also then Bogolubov came along. He was a well-known Russian physicist. You could see the Russians were together in a little huddle there and never talked to anyone else. People were watching each other all the time, wondering who was going to be the influential one. Sara thought that they were watching, they did not know what to think about me. You see they said maybe I will do something and they better be on my good side, but then maybe I will not and may I do not count. They were constantly eyeing each other hoping they could get

something out of each other and getting positions and trying to get them.

**Wilkins:**

Of course, you want to get formulae and predict things and so on, too. Don't you? But you are viewing it in a wider sense.

**Bohm:**

Yes. For example, when I wrote my book Quantum Theory, I had an interweaving of the mathematics and the physical ideas and some of the reviewers pointed that out in a favorable way. In fact, students who took the course liked it. But once they get a bit older and they get conditioned to these formulae, then they get to the point where they do not care about these things. I gave a talk around 1970 in Tel Aviv to the physics department and one of my students was there, former students was there. I started talking about the implicate order. He says the standard form of a talk is that for ten minutes the physicist gives his philosophy. Everybody falls asleep, because the philosophy is just bunch of arbitrary assumptions anyway. Then, when the first formula appears on the board, everybody wakes up. I

talked about twenty minutes, half an hour, three quarters of an hour, there are no formulae, then they suddenly realized there was not going to be any and they missed the talk because they hadn't been listening. The point is that the standard opinion of physicists is that philosophy is just a bunch of arbitrary assumptions and that the real thing is the formula. Everybody understands the formula and agrees with it and says that is what gives the results.

**Wilkins:**

I suppose they think the formula expresses the philosophy.

**Bohm:**

Yes, but they do not have any — nobody takes the philosophy seriously. They don't really think it counts.

**Wilkins:**

The formula is an expression of the philosophy, so ultimately, if they want to understand what the formula means then have to sort of understand the philosophy.



**Bohm:**

There are all sort of further assumptions, which are behind the meaning of the formula, which people do not examine. They do not even know that they are there.

**Wilkins:**

And, taking a very short term view of the matter, you mean, essentially.

**Bohm:**

My view is to say that mathematics and the physical ideas, the intuition and the philosophy should all go together. In the earlier days that was more common. But now as time went on and physicists get conditioned. Each generation goes further in that direction. They get text, which they present you which shredding is equation and say, "This is it," and say a few words about it and then say, "This is what you do with it," and that constitutes understanding. I think that each generation goes deeper and deeper into this thing and the quality of teaching gets worse and worse. It gets more and

more technical, and a technical virtuosity is regarded as understanding.

**Wilkins:**

Occasionally, there are a few things in the other direction, but not very many on that.

**Bohm:**

I think it is part of the spirit of the age, which is not interested in — I see which finally boils down to cost effectiveness and things like that. No real value for money and getting results. What results can you get?

**Wilkins:**

It means cost effectiveness in a very short time limit and sense. It is sort of geared to the whole business of politicians being in for three or five years or something. This is the sort of the ultimate?

## Interview Session - 7

**Wilkins:**

Well, Bristol.

**Bohm:**

Yes, we were discussing Bristol last time if I can recall. It has been a long time, before Christmas vacation. I think I mentioned that I felt a bit uneasy with the sort of pecking order in Bristol, the social emphasis on status and the people there.

**Wilkins:**

Yes, yes.

**Bohm:**

I am just reminding you, I will not to go into details.

**Wilkins:**

Price.

**Bohm:**

Price and some of the others and others not. Not everybody, but it was quite a bit of it. I found at that

time that it was very helpful to talk with Professor  
Turner in the philosophy department. We talked  
about all sorts of questions. It helped to revive my  
energy sometimes.

**Wilkins:**

In the philosophy department?

**Bohm:**

Yes.

**Wilkins:**

He was not a scientist?

**Bohm:**

No, he was not, but he knew a little of science and  
then there was Paul Feyerabend who was interested  
in the philosophy of science.

**Wilkins:**

What department was he in?

**Bohm:**

Philosophy.

**Wilkins:**

In Bristol?

**Bohm:**

Yes, during that period. He had just come from Popper [?]. He had worked with Popper.

**Wilkins:**

He worked with Popper, did he?

**Bohm:**

Yes. He got his degree probably working with Popper, and then he went over to Bristol for a while, and then he left Bristol later.

**Wilkins:**

Did he then go on to Berkeley?

**Bohm:**

I do not know where he went, but he was moving around quite a bit. He went to Berkeley and now he is also in Zurich.

**Wilkins:**

He is now also in Zurich.

**Bohm:**

He spends part time.

**Wilkins:**

Does he?

**Bohm:**

We discussed — we found — Discussing the philosophy of science and philosophy more generally was helpful to make the thing more tolerable. There was not much interest in that in the department, well, perhaps a little. Other things that happened, during that period I worked with the two students, Aharonov and Carmi, who came with me from Israel, Yack Aharonov, and Gidon Carmi. We worked on the problem of measurement in quantum mechanics and wrote a few papers clarifying certain aspects of the technical aspects, which I do not know if I need to go into, how the measuring apparatus works. Aharonov got the idea at that time of

considering a line of flux in a magnetic field, considering electron beams split in two, so half would go around one side and half around the other and then they would recombine to produce interference. He showed that the interference pattern would be shifted according to the strength of the line of flux, even though the electron beam never came into the line of flux. We wrote a paper on it. Some people found it, most people found it very puzzling. Those who really understood quantum mechanics accepted it after a little thought, but for years people have refused to accept that. Again, many people come up and they want to find a hole in it because they do not like the idea of the electron being affected by a field that it does not contact.

**Wilkins:**

When you say does not contact, is that in the sort of classical sense?

**Bohm:**

No, in any sense. The electron being split, it spreads about a millimeter or so and comes around. The line of flux is much smaller and the electron beam never enters the line of flux.

**Wilkins:**

It is a very localized magnetic field.

**Bohm:**

Yes, but by changing the strength of it, you can change the interference pattern. This is a peculiarly quantum mechanical effect. It is not very different from what determines the energy levels, which are the number of waves around a circuit must be an integer. People do not mind that. That is a non-local effect, but they get worried about this, because it is sort of outside the atom on a fairly large scale.

People might accept something like that inside an atom. For even now, we get papers coming up trying to disprove it and it is getting a bit boring to keep on answering them with after twenty-five or twenty-seven years or more.

**Wilkins:**

Has it been verified in any direct way?

**Bohm:**

It has been verified in any number of ways, and recently the Japanese have verified it with



tremendous accuracy. They have sort of screened the magnetic field completely when metal and by superconductors and by everything to make sure the electron could never affect it. That does not change anything. People kept on trying to find a way out because they do not like the idea. Quantum mechanics plainly predicts it. If they had found a way out, they would have been in a hole. They would have had to say something is wrong with quantum mechanics. They tried to show that there really is a magnetic field somewhere producing the effect. Finally, these Japanese have essentially made it clear that there is not. With Carmi, I worked further on the plasmas and the separation of the individual and the collective behavior that we discussed earlier. We developed some nice mathematical way of dealing with it, which he pursued later after he left, but very little interest developed in it. I had thought that maybe if there was a lot of mathematics, people would get interested in it, but apparently, that is not enough. Many people found it hard to understand. You got to have mathematics which looks as if it is going to produce a calculable result fairly readily, then they will get interested. Because now, for example, super-

symmetry and the screen theory have tremendous structures have been up, but essentially no experiments. It is the structure of mathematical speculation. Sometimes I find it hard to see what is going on in physics because they say that the things I do are too speculative. They admit that it may take twenty, thirty or forty years before they can compare it with an experiment. Who knows? It seems to be worth doing, so I am trying to find out what is it that makes it worth doing in their eyes.

**Wilkins:**

In fact, it is a little bit like packaging for the selling of toothpaste, or something?

**Bohm:**

I do not know. Why do you say that?

**Wilkins:**

I mean the thing is that in trying to get people interested in buying something, you have to use rather sort of not terribly rational approaches, which is though getting scientists interested in studying ideas [???

**Bohm:**

Scientists physicists have the notion that mathematics is the proper vehicle of truth in physics.

**Wilkins:**

Because you have said that mathematics or not mathematics is not the sole criteria [inaudible].

**Bohm:**

No, because there was Carmi's stuff, which was very good mathematics, but they do not seem to pay any attention to it. Maybe they found it too difficult. They could not see how you could calculate something. I cannot really guess exactly, because. You see, this present mathematics, you can calculate all sort of things, but you cannot compare any of them with experiments and they are all infinite anyway and approximations are out of control and so on. It is part of the accepted, I mean, what people have come to accept as the right way. But anyway.

**Wilkins:**

It is like having confidence in the currency, so to speak.

**Bohm:**

Yes. I think it was in 1959 when I went to a conference in Utrecht on solid state electronic plasma theory and all that.

**Wilkins:**

Which year?

**Bohm:**

1959. I was still in Bristol. Pines was there. I think he had me invited. Remember, that Pines had gone on ahead after the work we had done and he had become quite an authority on that area. When I got there, I found it was strange, you see. First of all, I listened to the papers and there was nothing, they just filled the board with equations and I found it boring, because they did not even calculate any experiments. They just talked about their equations. It seemed that they had changed over from the method of what I called canonical transformations, which I had been working on, too. They were not called diagrams, Feynmann diagrams, which are sort of a way of working out certain calculations quickly. Somehow physicists felt much happier about that.

They felt confident that they were talking about something with these diagrams, that they understood it. But I felt that they did not, that these were just technical devices for manipulating the formulae. I remembered telling somebody there, saying, “I do not really understand what is going on here.” And he says, “I do not understand what you mean by not understanding or what you are doing by understanding.” So, we were somehow not communicating. He felt that manipulating the diagrams made it all perfectly understandable. I felt that there were no physical concepts in it.

**Wilkins:**

Yes, but presumably, if within a group, if everybody is doing the same sorts of manipulations, they all start building up a sort of confidence that this is valuable. It must be valuable because the other people are doing it.

**Bohm:**

Yes, and they all feel that since everybody says, “I understand,” when you do it, then we understand.

**Wilkins:**

Yes, although none of them really do.

**Bohm:**

They understand the manipulations, but then I say they should have some deeper understanding, but they did not see the point of that. They felt that it was already very deep.

**Wilkins:**

But I mean in that respect, it is like confidence in currency, is it not? Currency does not have any value at all unless there is confidence in it. The confidence is built up by [inaudible].

**Bohm:**

I think these equations are the currency of communications. You have to be able to talk in terms of the prevailing currency to translate your ideas into the prevailing currency or else you cannot use it in that particular group.

**Wilkins:**

Is it a common illusion of greater rationality and so and it actually exists?

**Bohm:**

Yes. Aside from that, at first the spirit there was very poor. Very competitive people watching each other. Sara was saying that people did not know what to think about me. They said, “On the one hand, I may not be of any value to them at all. On the other hand, maybe I will do something that it would be important to be on my good side.” Then the Russians came in a solid little group, which would never separate and never say anything to anybody else. All suspicion and fear. There was Bogolubov and everybody was orbiting around him, all the Russians and satellites, all looking very grim.

**Wilkins:**

They do that at these international peace meetings, too. I think it is, well, various reasons why they do it, but anyway.

## **Bohm:**

Then people — One felt they were just watching each other and wanting to get ahead and get status and see how they could advance themselves through these conferences. It did not really make a good impression on me. Then, later when I saw this mathematics which Carmi had done on plasma, that made no impression, I began to gradually lose interest in the subject, because I said, “They do not want to consider any ideas at all, not even mathematical ideas.” Because, for a long time I said, “Well, maybe the reason they do not want to pay any attention to me is because it is not mathematical enough.” But here, it was made very mathematical. Since that time, several people have said, “These are good papers,” but, unfortunately, not pay attention to it. It became unclear to me what in the world was the currency?

## **Wilkins:**

But you say that Pines had taken up some of your ideas?



**Bohm:**

Yes, but he translated that into the other currency.  
Sort of made an exchange to the other currency.  
There it caught on very nicely.

**Wilkins:**

Yes. In a sense, he did package it meaningfully.  
Maybe you should get an advertising agent working  
for you.

**Bohm:**

It was not exactly packaging. It is a matter of putting  
it — Suppose you have money from some country  
— you have to put it into the local money to be able  
to buy things. People will not accept your money.  
The thing is, it has to be put into the local currency.  
Now, the local currency is diagrams and  
manipulation of formulae.

**Wilkins:**

In a sense, it is like currency and so far as it is not  
the thing itself, but it is what the thing is presented  
to look like. Packaging does not just mean in the

physical package you put it into. It is the whole sort of image of the thing.

**Bohm:**

The image is that you have a set of formulae, which in principle you have a method you could just work out, if you were proficient at it, you could get the answer to everything, just crank along. It looks that way. Obviously it is not that way and everybody knows it is not that way, but as long as it looks that way, it is acceptable as currency. I began to feel that either I was not in sympathy of what was going on physics or that these people were somehow not really serious. My interest began to go down slowly over a couple of years; my interest in the plasma stuff went down. I went to other conferences, too, where I found a very similar spirit, also tremendous emphasis. Some people were making themselves big shots and they were emphasizing their status. At this Utrecht conference, Pines got up and made a little talk about trying to tell people about what I had done. I felt uneasy about this whole thing, why he should do that or why?

**Wilkins:**

Why did you feel uneasy?

**Bohm:**

Maybe he felt a little guilty. Because, for example, Pines had written, I do not know if I would put this in the book, but Pines — When I was in Brazil, we had done two papers already on the plasma and the last two were to be done. Pines wrote up the last two, and he said that he would put the last one in his name first, because he had to get a job. I was too busy in Brazil with all sorts of worries to answer him back.

**Wilkins:**

You mean [???] of names [???] ?

**Bohm:**

Yes. Therefore it would look, that was the one where all the calculations were done. Physicists say that is the real stuff anyway. All the other stuff is just getting ready for that. Later, I learned that that was the way physicists think, that the people who do the calculations are the ones who really count. They say

others like Feynmann provide insights, which, however, are useful to those who do the calculations, who are really doing the, what do you call it, the bread and butter of physics; really the solid stuff of physics. I must have become useful to those who do that than has no value, but the one who does that is the one who is really doing it and therefore, that is the one who counts.

**Wilkins:**

Who makes the idea sort of gives them a concrete form?

**Bohm:**

Yes. In general. See, when I got there, I had the distinct impression anyway that these ideas were being attributed to Pines and probably, in subtle ways, perhaps unconsciously, had been doing that. He already did it openly in that order in which he put the names on the paper. Then he may have felt guilty or he felt regretful, you know, somehow.

**Wilkins:**

But did any of these remarks he made, were they published in writing?

**Bohm:**

No, they are not published.

**Wilkins:**

It is very easy for people to get up and make fine speeches which probably are not even recorded, like that. What counts is what goes down in black and white on paper.

**Bohm:**

I think I was getting a little depressed there in Bristol for all these reasons. I became interested — I was beginning to feel that physics, you could not base everything on physics, your whole life on physics. I had already been looking into philosophy. I began to look at other things. Sara and I used to go the public library and look at the sections on philosophy, religion and mysticism and so on, looking at some broader issues. The question really was something deeper that would have meaning or value. It seemed that physics did not have as much meaning as I thought it had. It turned out to be not so different from, let us say, business. A businessman does whatever will please his customers and get him

money, get him whatever he wants. A lot of physicists seem to be in that boat. They found out what was wanted and did it and hoping thereby to gain various advantages.

**Wilkins:**

It was a bit like your father back in the furniture shop. You put the right things in the window and people came and bought them.

**Bohm:**

If you get what they want and they buy them, then you get along. That is a way of living all right, but I felt it has very little meaning. Just because people happen want, they need the items, obviously, the furniture, but just because people happen to want certain things is not a very good reason for devoting your life to getting them for them. At least, you get them solid items, like furniture with the business, but here just give them ideas or calculations. Give them the calculations they want or the results they want.

**Wilkins:**

Incidentally, about the competitive spirit, when I reading this book about the Lawrence Livermore laboratory, there was quite a bit in that about Caltech and apparently, a young scientist going through Caltech, this would only be in the last ten years or so, find it highly competitive, enormous pressures on people. I think the spirit in a center like that can?

**Bohm:**

I certainly found Caltech a terrible place.

**Wilkins:**

Yes, you did, but evidently this, I think the traditions can go on in institutions like that and the same spirit was still very strong, apparently.

**Bohm:**

I was beginning to search for a deeper meaning even beyond what could be found in philosophy as well as science. Looking at these questions, two people I read at that time were Gurdjieff and Ouspensky. I do not know if you know them.

## **Wilkins:**

I do not know them, but I have heard of them.

## **Bohm:**

The idea which they proposed seemed interesting to me which was to become aware of your own thoughts and your reactions and all of life, which are irrational and the source of most of the trouble. For example, Ouspensky said he used to watch the people in the underground. He felt they were like sleepwalkers. They were not aware of what they were doing. They were just driven along to their jobs or wherever by forces inside of them or between them which they were not aware of. It seemed to me that these forces were driving us and driving the whole world into terrible situations. It required a sort of awareness. I also read Buddhism or oriental philosophy, Indian philosophy, yoga, and probably some of the Christian philosophers. During that time this is the story that Sara picked up this book, First and Last Reading, by Krishnamurti. She noticed the phrase, the observer and observed, and thought I talked about it all the time in quantum mechanics, so she thought maybe it had something to do with that



and she gave it to me. I found the book extremely interesting. I read it as fast as I could. Then I looked for more books of his. They had a few more in the library. I then wrote to them and asked if there were more books and I got an answer and ordered some more. Finally, I asked if I could meet him. It turned out that in June of 1961, he was coming to London for the first time in many years (he had been ill) and that we could at least come and listen to him. While in London, I wrote to meet him, although they said that he was not meeting people, but still I wrote to this Doris Pratt and she answered finally that I could come and see him. So I came with Sara. This went off very well. I felt that in Chrishner — let me explain that in the writings, there was something there which seemed to be very relevant to the whole human problem, the question of meaning, which was not only this self-awareness that Gurdjieff and Ouspensky had been talking about, but something much deeper. It is very hard to put your finger on it, but I sort of felt that non-verbally at first. The question of the observer and observed was raised, for example, to say that they were not really separate. I felt from quantum mechanics this must be very significant. He was applying it to the human

being himself, saying that the human being as observer was not different from human being as observed. Now, this is a very deep point because usually, a human being regards himself as an observer as separate from the observed, even when he is looking at himself. He thinks that he is standing back looking at something inside of himself. But these two are actually one. The confusion that they are separate is the cause of tremendous misery, at least that was saying. I had sort of an intuitive feeling this was right. He was also hinting at something much deeper, some ground, some emptiness in a wholeness ground which everything came, which if we could contact that, then we would sort of rise beyond all these daily problems into a totally different area, where, therefore, we would not be caught in them.

**Wilkins:**

I did not realize that Gurdjieff and Ouspensky would you say one of their main points was to become conscious of one's own thoughts?

**Bohm:**

Yes, and feelings and reactions and how irrational they are.

**Wilkins:**

Did they have any kind of discussion about how one did this?

**Bohm:**

Yes, in many ways. Ouspensky used to say, “Remember yourself while you are in the mist of something.” Gurdjieff used to give all sort of trick methods whereby people would be sort of shocked into noticing themselves. They were sort of extravagant. He would get people to do all sorts of crazy things, because they were trying to serve him until they suddenly realized what they were caught in. They were just trying to make an impression on him. They had been doing all sort of absurdities. Typically, for example, he used to invite people to eat with him and he would prepare enormous elaborate meals and drink, and even those who did not want, he would press on them. He would get them to go along with him against their will,

showing that they really had no will. He did not say that, but the ultimate meaning of it was they had not any. Through this, they would be awakened into looking at their real reactions, what is really going on.

**Wilkins:**

Did he have small communities?

**Bohm:**

He had something like a small community, and so did Ouspensky. It was not a permanent community, but people came somewhere to Richmond or somewhere like that once a week over the weekend.

**Wilkins:**

I think some people thought he was so difficult in these places I think.

**Bohm:**

Yes, well some people find them tremendously helpful, I know, and some got into difficulty. I never was attracted to them enough to want to go on with their stuff, but I thought the points they raised were interesting. But Krishnamurti was the only one that I

felt really whole-hearted about. I think that was a crucial point that occurred just as I was about to leave Bristol. I talked with Krishnamurti and we got on very well. He seemed totally open. Also, Sara felt that way. I said I would talk about my scientific ideas, which I did. He could not have understood them, except the general spirit, but he was very open in listening and attentive. At one stage, when I said “totality,” he grabbed me and said, “That is it, totality.”

**Wilkins:**

You sometimes get a feeling for the spirit of the thing without really able to grasp it in any very clear intellectual manner.

**Bohm:**

Yes. I think for a long time that was the feeling about Krishnamurti. It was opening up the notion of not only a self-awareness, but also going much deeper into the nature of being and the mind. An awareness, attention that would transform the mind and transform the human being. I felt that was necessary, that probably without actually formulating it, I began to feel that nothing was going

to solve the human problems that I knew about. Science would not solve it. Politics was clearly was not going to solve it. We had seen after the 20th Congress what had happened to the people who wanted to solve it by socialism. Hegelian philosophy would not solve it. It was interesting enough, but it would not solve it. It interested me because it went into this process of thought itself, which I felt was where the trouble is. Even in Israel, as I told you before, I had been interested in thought. Essentially, I remember one minor work I had at the time, that feeling was more powerful than thought, but thought would win in the end, because it continued. It kept at it, and feeling would only hold for a little while. In other words, it would give way eventually to the pressure of thought. Not that I favored thought, but I am saying that thought would win and produce all sorts of destructive effects because it could just keep at it, like Stalin, day after day, putting in his men here and there and sort of knocking out everybody else. When I felt it was really necessary to really understand the workings of thought, the nature of thought beyond just simply the content, but actually the process, how it operates and this irrational destructive way getting people to fight each other

and nations, between groups and inside families and what not, because of the way they think and because of the assumptions they make. No prejudices.

**Wilkins:**

Yes, but I mean you have yourself said that you cannot really separate thought from feelings, so [inaudible].

**Bohm:**

No, you can't, but thought has come to dominate feeling. Thoughts can start feelings. For example, people came by marching and shouting and singing and crying, you see, the feelings stirred up. But that happens without all that inside the individual.

Thought will keep it up and will then impose a set of feelings, so you got to feel this way, you got to love your mother and your father, and you got to do your duty, you got to be a patriotic, you got to this, you must present this image and feel this way and so on. Therefore, this constant pressure means that the spontaneous feelings gradually get worn down and go to sleep. What I call the thought feelings take over.

**Wilkins:**

Is it partly because I mean thought gives you this illusion of concreteness and reality.

**Bohm:**

Yes, well that is part of it. More recently I put it like this to say thought imposes a show in consciousness, a show of reality. Every thought contains not only the image and the imagination, but also all sorts of feelings and neural chemistry. The thought that somebody is your enemy will contain various neuro chemicals that will stir you up. Comforting thoughts will produce endorphins and you feel nice. Then you remove those comforting thoughts and the brain demands to have them back. You are sort of hooked on them.

**Wilkins:**

You mean the show is something which has the illusion of being concrete in so far as it has a great mass of detail.



## **Bohm:**

Yes, and we call them props. Let us think of the play in an act. Every play requires concrete props. These are all the props. Other people may be the props, society maybe the prop, and money may be the prop for the show. The person has the show about himself and about his world. This show contains all sorts of neuro chemicals, and when the show cannot be put on that way, the neuro chemicals are disturbing and the brain just physically, like as in the case of morphine, demands to have them back, and puts a pressure on thought to produce false ideas and illusions, that will bring back the show and arrange props that will do it. The point is then that there is the show of the self. There may be a real self, but this is hidden, whether there is or not we cannot say yet because it is hidden by the show of the self. The show of the self is the primary difficulty with thought, because it takes on such importance that thought is distorted by it and emotions are flooded with it. The neuro chemistry is flooded. The whole system is flooded. Everything is arranged so that the show must go on. This was a point that Krishnamurti was raising in his own language that it was this self-centered thought which was the cause of the trouble.

And essentially, there would be a way of being without this self-centered thought, which the mind would be intelligent, quiet, alert, and silent. Let me try to put it like this, which inside, in this whole process, there is a number of illusions. One is the illusion of an observer who is observing the thought. Consider a play going on, a play within a play, like Hamlet. You have these various actors who are looking at the play, another set of actors are directing the play and who are changing the scenery and arrangement. If somebody outside is just looking at the play and he says all these people are looking at it, it's being directed, acted, and so on. He realizes that the play is a show, but all the rest of it is taken as real, that they are putting on the show, but in fact they are not putting on the show; they are part of the show. Something similar is going on in the brain. When you think it is clear that a show is going on, the imagination puts on a show of what you think. But then you also have a show of an observer who is watching the imagination, and the experiencer was experiencing it, and a doer who was doing it, but these are all part of the show. Thought puts on the whole show as if from a tape in memory.

## **Wilkins:**

Paul discusses the question of the infinite regression of one level observing the person who is observing [inaudible].

## **Bohm:**

Yes, but then we get out of this infinite regression because we say that there is no observer. That is essentially what Krishnamurti was saying that there is nothing but a show of an observer, a show of an observed, but the show is put on by thought. Therefore — if you try to analyze it the usual way, you get the infinite regression, but this way, you say there is no regression, but, in fact, there is an intelligence which is asleep, which therefore there this show is putting on the show of an intelligent observer who is looking at it. But there is no intelligent observer. It is like a sleepwalker, as Ouspensky was saying, that the sleepwalker is dreaming that he is awake and looking at it and directing it, and so on. The point is therefore you need an awareness, an attention to all this, to see the actual process of putting on the show as such, because the show is put on in such a way to conceal

the fact that it is a show. There are all sorts of devices for concealing that it is a show, making it look very realistic. The props are part of it. Also, insensitivity is part of it, and dullness. Therefore, as long as this goes on, the human affairs cannot be —

**Wilkins:**

How do you mean insensitivity as part of it?

**Bohm:**

You see, the brain becomes insensitive to all the evidence that this is a show. It will not pay any attention to it. It also denies the evidence presented with it and says it is not the evidence.

**Wilkins:**

Yes, it is selectivity.

**Bohm:**

So, it is distorted. There is a neuro chemical pressure within the show to defend the show and to defend the concealment of the fact that it is a show.

Therefore, as long as that goes on, the human life has very little meaning, because everything is arranged to try to defend the show. All real things

must be organized to defend the show, so they are hiked as props to make a nice show. Therefore, they are not really being seen as they are. The whole thing is therefore — you know, it is irrational meaningless ultimately. Therefore, from that point of view, seeing through this was the crucial element because as long as this goes on, science is part of the props for the show, religion is another part. All the activities of human beings are props for the show. As you can see what happened in the Soviet Union, they wanted to change and have socialism. They could not. Karl Marx was somewhat aware of this. He said there is such a thing as false consciousness. This show, which is concealed, is false consciousness. It is not really inaccurate, but it is committed to be false in order to maintain the show. It has a false structure. Marx was aware of this. He called it “false consciousness,” but he said it was due to exploitation of class by class that the bourgeois, in order to justify exploitation, had to have a false consciousness of what was going on, both for themselves and for the workers. When class structure was gone, consciousness would clear up and it did not. This goes back far beyond this to ancient times, or even to our primate ancestors. If

you take the chimpanzees, for example, Jane Goodall, who has lived among them, said that sometimes a group of dominate males and a few females conceive a dislike for the chimpanzees on the other side of the mountain. They were organizing gangs and going out and kill them, beat them up and kill them, get pleasure out of it, drink their blood. It lasted a little while. They were rather like street corner gangs who fight, who enjoy fighting. The point is that if the neuro chemicals can be stirred up by thought, you will have that going on. Now, if you take a dog, it will not work because the dogs' brain is not big enough. We used to have a dog in Brachwhen [?] who would get furiously angry when she met another dog. I was taking her for a walk and it took all my energy to drag her along. But as soon as we went around the corner, all this stopped and she suddenly wondered why she was so excited. She could not make the picture of the other dog, which she hated so much, and therefore continued the quarrel to keep the neuro chemicals going. Now, the chimpanzee can do that. It has a much bigger brain. The human being can do it much better, can do it for hundreds of years. The neuro chemistry eventually runs the show. When you set up a revolution, hate,

fear or violence, everybody has an — the neuro chemistry runs the show and eventually, you end with the Mafia.

**Wilkins:**

Yes, but you are not saying that it not of ultimate reality. You are saying that it is an essential element in running the show.

**Bohm:**

But it is running the show now. It is the major element now. It should not run the show at all in an intelligent operation. The neuro chemistry should be serving intelligence. The right neuro chemicals state for the right operation.

**Wilkins:**

Yes, you mean there is not enough sort of general intelligence behind it, and it tends to run itself.

**Bohm:**

It puts the intelligence to sleep. When there is hate, fear and violence, the intelligence goes to sleep, therefore, the show runs on the neuro chemistry.

**Wilkins:**

Yes, but just as you say that Marx had all his ideas and then it did not work out really very well in practice, and of course, Krishnamurti had all these really good ideas and they did not work out [inaudible].

**Bohm:**

I am saying that no they do not. I am not saying that we have a solution. I am trying to say that it begins to throw light on it. We will have to come further to what I think is needed. As we go along, say that we find there were ways in which Krishnamurti's ideas did not work either, but at least it throws light what was some of the things that are missing. That they did not take into account that the very constitution of the human brain has this problem in it, which far antedates any particular social thorns.

**Wilkins:**

Yes, but I mean you would also say that Marx's ideas were casting some light on the nature of the problem, too.



**Bohm:**

It casts some light, but then we say that we have to cast some more light.

**Wilkins:**

Yes, sure.

**Bohm:**

Certainly, the social structure and the exploitation helps to maintain the wrong neuro chemistry. It is an important cause, but there is more to it than that. Especially, since the people who want to change this structure are already in the neuro chemistry of the structure and their intelligence is largely asleep, as you can see. I have been sort of anticipating things that came much later, but at the time these things were by no means so clear to me. I just had an intuitive feeling that this was an important point, what Krishnamurti was talking about.

**Wilkins:**

So what you are talking about is these general philosophical psychological notions. This was not

being related to physics in any very specific manner, right?

**Bohm:**

Except that I felt physics had the observer and observed, and also I felt that physics by itself clearly was not enough. I had enough experience to make me feel that way.

**Wilkins:**

But you mean that in physics there was a specific problem of the observer and the observed, which did sort of form a parallel, when they think about the human beings sort of generally. But you were not using these philosophical notions any way directly in the physics of that time.

**Bohm:**

No, but I had the feeling that they might be of some value in the physics. And vice versa, I had the feelings that physics might help to clarify some of these notions.

**Wilkins:**

You mean as.

**Bohm:**

Not only by a parallel, but also because we would have to bring in a parallel between the material structure of reality and the mind in order to make these notions more clear. But if we found that matter was one way and the mind another, the whole thing would be extremely unclear. I felt quantum mechanics was indicating that there was quite a parallel between the two.

**Wilkins:**

When did you leave Bristol then?

**Bohm:**

It was really '61. The summer of '61. I started in the fall of '61 at Bizkbeck.

**Wilkins:**

How long had you been at Bristol?

**Bohm:**

Since '57, so it was four years.

**Wilkins:**

I thought you said that Eric Burrup had been helpful?

**Bohm:**

Yes, he had been in the sense he suggested it. He knew Bernal, so he suggested I apply, which I did. I remember I went before some committee. Bernal was on it.

**Wilkins:**

They had vacant position?

**Bohm:**

They had a vacant position. Eric said it is not a plum, but it is a good way to get started. You might move later. It turned that I did not move, but I applied, there were very few applicants at that time and I got the job quite readily.

**Wilkins:**

You left a chair of theoretical physics.

**Bohm:**

That is right. There were just one or two other applicants, but I got the job. There was not a tremendous rush of applicants, because at that time there was a shortage of physicists.

**Wilkins:**

Maybe Bizkbeck was not regarded as very sort of leading academic place.

**Bohm:**

No, but I felt that it was good to get out of Bristol and Eric felt that even if I was not happy at Bizkbeck, then I should try somewhere else, but meanwhile, it was a good step.

**Wilkins:**

Yes, well, I mean it was a well-defined top academic position, which you are quite right really important to the value you attach to yourself once you?

**Bohm:**

I do not know if I can think of anymore, but?

**Wilkins:**

What about Pauli?

**Bohm:**

I was teaching this course, organizing it, to combine weaving mathematics and physics together and concepts. Also, I was developing what I would call sort of a world view of integrating physics in broader areas, a sort of a cosmology. I cannot really remember now, but in my inaugural lecture I gave sort of a broad overall view bringing together physics and models and quantum mechanics, and the notion of the basic idea that the reality is not static object, but flowing movement. The old Eric Heithen [?] idea that what is, is movement. The forms which appear such as vortices are relatively constant only and relatively independent, so to explain all sorts of objects, particles and so on that way, and to build up into larger structures and eventually to understand things much more broadly that way.

**Wilkins:**

If you took Hegel, would he regard the dialectical process then as being the ultimate reality?

## **Bohm:**

The trouble with Hegel is I was essentially adopting the view of the material processes, the reality, and then we were thinking about it. I was very interested in Hegel, but I had not yet integrated that into the physics. I was using Hegel as sort of a parallel to physics rather than really integrating it at that stage. For Hegel, the basic reality was mind, the universal mind. You could think of what people have called God as way of personalizing it. The mind is a process. This was his essential step, assumption. He regarded it as a perception. He said, “You must pay attention to thought as a real process, not just to the content.” Usually we are trained to pay attention to the content of thought and ignore its actuality as a process.

## **Wilkins:**

You mean thought has movement?

## **Bohm:**

Thought is movement, not only has movement, but it is movement. Its movement is what it is. Since it is a process, the things which appear as content are

rather likely femoral forms of vortices, and, therefore, the pictures we get in thought and the words, the concepts and so on are like that, but thought itself is a flowing process, which we do not immediately see because we are trained not to see it. We are conditioned not to see it.

**Wilkins:**

So that is the dialectical process?

**Bohm:**

We call that the dialectical process, which Hegel said goes by way of opposition, going from the thesis to the antithesis, then what he calls its aufgehoben [?] into a synthesis, which means it is both kept and discarded, that the old thing is discarded, but in a sense its kept as a sort of a moment, as an aspect of the new, but not with independent reality. But then these are still only forms within the process, but the process itself is only implicit, it is deeper than the forms, which I just recently called the “show.” The forms which appear in thought could be called part of the show, the show of imagination, for example. The show of words. It helps to manifest the thought. Hegel used



that word to manifest a great deal. But the thought itself is highly implicit or [???]. This process goes on, and you can give it attention. Hegel is saying you are looking at the process of thought, not directly of your sense and impressions of reality. But ultimately he wants to explain what appears in the sense impressions as the thought of the universal mind. So since we say matter is what the ground behind our sense impressions, therefore, he is explaining matter as a kind of feature of the thought of universal mind, in which universal mind ingenerates the show of another, which is actually no other, but itself. Just as in your own imagination you generate the show of something else, but it is actually yourself. The process of it is yourself, the reality of it, the actuality of it.

### **Wilkins:**

So using your language, then that is saying that matter is a sort of explicit order.

### **Bohm:**

Of thought. Of universal mind.

**Wilkins:**

Yes, and this now, just a minute. The flowing process is the mind or the way the mind is working?

**Bohm:**

The flowing process in Hegel's view is the ground of the mind. He says there is nothing but mind, ultimately. That is his idea.

**Wilkins:**

The ground of the mind, but the ground is sort of, the mind is sort of more explicit?

**Bohm:**

No, he does not carry it that way. Questions like that are raised in Oriental philosophy, but his is saying that thought is the basis. The flowing process of thought is the basis, universal thought. That is for him the situation. The show which appears in it, which includes the manifestation of thought is not only inside, but outside.

**Wilkins:**

So, inside.

**Bohm:**

Not only inward in the human being, but it is what he sees. Ultimately, the outward is part of that show, too.

**Wilkins:**

Yes, you mean the outward being the matter?

**Bohm:**

Matter as we see it, the essentially perceived world.

**Wilkins:**

And the inward, your speaking about the processes in the mind? At the core.

**Bohm:**

That which you plainly recognize to be process of mind. Immediately you sense that this is mind and that is matter, but ultimately, even — You say ultimately both are mind, but of a deeper mind.

**Wilkins:**

Yes, I see, so that the moving process then includes the matter, what you recognize as being matter and also mind.

**Bohm:**

Yes. I was sort of trying to bring mind in a little bit at that stage, but I was primarily trying to describe the dialectical process as taking place in a very subtle kind of matter. For Hegel, you have this — See, Hegel, in a way, also had this question of the observer and the observed, because when thought produces the show of the other in imagination it is no other really, but there seems to be an observer who is observing the other. That is part of the show. So thought produces the show of two which are really one, but in reality they are one. But thought has to make this distinction in order to manifest itself, but to understand thought, you must realize that it is only a distinction in the show and not a distinction in reality.

**Wilkins:**

Yes, I think I see what that means.

**Bohm:**

For all the distinctions made in thought are in the show. They may be useful to make or indicative. They help to do things and so on. But they are like the dotted lines you draw on a diagram.

**Wilkins:**

Yes. They may be useful insofar as you need to eat to keep alive, and if you could not eat to keep alive, then —

**Bohm:**

In order to make things and build things and do all sorts of things — To operate within the material world, whatever that means, you have to do this. Even if the material world were the thought of God, you still have to think that way to be able to handle it.

**Wilkins:**

I think that many [??] sort of somewhat favor the idea of not eating and letting your body go to pot so that you would then sort of just go off to God or something, but I think that is a rather sort of extreme

position, was it not. I mean most religions seem to attach some importance to life as we know it.

**Bohm:**

For Hegel, he thought there was an evolution going on of the spirit and with the help of matter in nature. That therefore, he did not ever say that he would not take that position, but he would say that the spirit evolved in going through this evolution, going through this process.

**Wilkins:**

But you mean by using evolution there, you mean he is thinking in much longer terms of kind of things like biological evolution?

**Bohm:**

No, spiritual evolution. I do not know if he thought of biological evolution at the time, but he is saying that humanity, by going through these stages of thought, was evolving spiritually.

**Wilkins:**

You mean like Dial Deshardan [?], you mean all that sort of things. That this is a long term sort of evolution.

**Bohm:**

Yes, but he thought it was very valuable to relate to nature and take part in matter in society and all that.

**Wilkins:**

So did you mean the continuing flowing process that had a very long term element into it, which is essentially sort of progressive or uplifting or something like that.

**Bohm:**

Yes, progressive evolution of something.  
Unfoldment you may call it.

**Wilkins:**

Yes, but this is on a quite a different time scale from the one of the, all the little vortices which are forming from minute to minute.

**Bohm:**

Yes, well that makes sense to say there are various — in this process there are slow, fast, some little ripples and changes and some much longer term changes.

**Wilkins:**

Yes, I think possibly he did not get on to the biological evolution one at all, because I mean they — I don't forget all the state of science so actually at the time.

**Bohm:**

There was not far enough advanced to say much about it.

**Wilkins:**

Yes, the evolution of living forms is somewhat different from the idea of the spiritual evolution and [inaudible].

**Bohm:**

But ultimately, for Hegel, it would not be because the physical forms are also ideas.



**Wilkins:**

Yes, ultimately, yes, but somewhat, at least is somewhat distinct.

**Bohm:**

Yes, but still ultimately, nature is the universal idea in its element of ugliness to itself. Externality to itself is what he called it.

**Wilkins:**

How much of this was in Heraclitus? Because, I mean, presumably Heraclitus there is not much —

**Bohm:**

There is very little known about it. No, just a few fragments.

**Wilkins:**

Yes, so there are just a few kinds of hints from Heraclitus.

**Bohm:**

Yes. Plato had a bit of it in his dialectic. But it is sort of continuous. Hegel regarded himself as the heir [?]

of all previous philosophy. Philosophy was also evolving in this way or unfolding, but it had reached its highest and Hegel or in the German state or wherever. Whether he thought it would ever go higher, I do not know. He is reputed to have thought that he had reached its ultimate, which he shouldn't have really.

**Wilkins:**

I think he was a bit distinct from many philosophers in so far as he just did see himself as part of a general process whereas most other philosophers I thought saw themselves as rather sort of more distinct.

**Bohm:**

Yes, well, he thought that he was the culmination of the whole process. But whether he thought it could go on from there or not, I do not know. To culminate to a higher peak.

**Wilkins:**

You said about Plato and dialectic, did you say?

**Bohm:**

Yes, well, Plato and Socrates. The Greek started dialectic and they were one of the earlier people who did it.

**Wilkins:**

You mean Socrates and dialogue?

**Bohm:**

Yes. I mean the dialectic was a method of questions and answers whereby you try elicit the truth by a series?

**Wilkins:**

You think to some extent that to grow out of Heraclitus?

**Bohm:**

Not necessarily. I do not know. Plato certainly knew about Heraclitus, and he brought in, you know, I think that he tried to?

**Wilkins:**

He made reference to Heraclitus?

**Bohm:**

I am not sure. But he brought in, he had a very dynamic element in some of his thoughts. It might have fitted. I do not know enough about it to say.

**Wilkins:**

I do not think he ever mentioned Democritus anywhere, did he, which I think has been commented on, because he was a contemporary. He must have known about him. I think he must have despised him no end.

**Bohm:**

I think that he would not have accepted a materialist philosophy.

**Wilkins:**

I see. That is what I mean. It would have appalled him. I do not think this has ever been commented on, but people have said that they were contemporary. They must have heard about it, no but a single mentioned word. Presumably, he thought he was unmentionable, despicable [???

**Bohm:**

Well, he probably did not think it was worth commenting on it. I think to do it?

**Wilkins:**

I think he regarded it as being?

**Bohm:**

Nothing to do with the truth.

**Wilkins:**

Right. I think this sole thing you see is relevant to the whole business of the Monos [?] and the molecular biological now. The thing is that one can pick holes in what Monos said and deride it and so on, but the basic notions of Monos are living in molecular biology now. People are going on and they are developing these ideas, and they are working. This is what we have to face. I find it really rather disturbing. It is not a load of poppycock. In one sense, it works. I am not quite sure about the AIDS virus thing, but I mean all kinds of biological problems from a both practical and theoretical nature, it is beginning to creep into, but I still feel

most of the signs are supported by Jim Watson saying we do not suffer from the German disease.

**Bohm:**

What is that?

**Wilkins:**

Interest in philosophy. That is what Watson said. He boast of it. I do not suffer from the German disease. He said that in London a year or two ago and we get on with the job.

**Bohm:**

Yes, well, I will have to look into that. It is the same as to say technical is working too in a certain sense, but it is not producing — the overall long range results are not being produced. You cannot say that people are really better off than they were in the '60s or after all that technology.

**Wilkins:**

I think the molecular biology is having the subtle spiritually destructive forces and the people who are not working in the field, of course, it gives them the

creeps. People are working just get hooked on the drugs [inaudible].

**Bohm:**

Well, they get the endorphins. They get all the neurochemicals because it is exciting problems.

**Wilkins:**

Well, it is their life. It is their careers, their money, their self-esteem and everything else. They are wrapped up in it. I interrupted there. You were saying that?

**Bohm:**

You could say that sometimes things work in a narrow context, but they are producing havoc in a greater context. It is like the idea of making a pact with the Devil, as Faust does. He got everything he wanted, but the whole thing was worthless.

**Wilkins:**

I think the Chinese [inaudible] who asked me to contribute an article in some popular scientific Chinese journal. Sort of the intelligent layman kind of thing. So, I saw him today, I said, “Well, look, I

wondered whether I could write something about molecular biology, some of the philosophical problems that it raises, and just raise the question as to whether the readers might think that traditional Chinese philosophy might be able to contribute to some these problems.” I would not be saying how to do it oneself, but I mean, don’t you feel that the whole — I mean I know little about it, the whole as being this big sort of holistic element in traditional Chinese philosophy, hasn’t there? And one feels that there might be something, possibilities there so why not raise the — And they are also so concerned about the value of the scientific workings of a broader social and political sense, aren’t they, with all the communism and Marxism and all that sort of stuff. And although they may be taking up the idea of purer science to some extent in western models and straight, forward application. Yet it seems to me they have a tradition there of thinking more widely about the significance of it, which is not so strong in the west. Anyway, I am getting off the point. Go back to you.



**Bohm:**

I was developing a kind of world view, a cosmology which included the notion of infinite depth of matter and infinite qualities which I had already put in my book, *Causality and Chance in Modern Physics*. I remember I used to give talks about it. There used to be groups of students who would gather for weekends in these grace and favor houses, like in Richmond Park, and I gave talks during those early years. Some of the people who were there said that my view was such as to make more room for the religious approach by giving sufficient richness and liveliness to matter, so that it would not be this mechanical structure that we were talking about.

**Wilkins:**

Yes, because I think it just is very difficult. It seems artificial to just sort of bring God into these mechanical pictures.

**Bohm:**

Yes, well that goes back, remember the Rosenkrenzer during the late middle ages. The scientific tradition included Rosenkrenzer and

various other, alchemy, which had the idea of matter being sort of alive almost and having God in it, you see that God imminent. The divine was imminent in matter. The church at that time regarded all this as a kind of heresy, a kind of rival to their own approach. Therefore, they conceived the notion that God would have to be totally transcendent, though this was really against Christian doctrine, and that the universe was just a machine. The scientists like this because it gave them complete freedom. Religion had nothing to do with this machine. God had made the machine and from there on it went, except for occasional miracles and the theologians gained the possibility of getting rid of all these heresies and witchcraft and all, everything having to do with the notion of some divine force in matter.

**Wilkins:**

[Restroom break] It is recording again.

**Bohm:**

I was sort of moving toward a broad cosmology and world view which would leave room for something more like spirit.

**Wilkins:**

That was in the early '60s?

**Bohm:**

Early '60s, yes.

**Wilkins:**

Were the student fairly responsive to this?

**Bohm:**

Some of them were. At least there was a good response to bringing in physical concepts along with the mathematics.

**Wilkins:**

The '60s was supposed to be especially, have all this special kind of interest in spirituality and wholeness and God knows what. Was there not?

**Bohm:**

There were a few like that in Bizkbeck, but I do not think there were a great many. There were people who worked in the day and came there at night.

There were a number who were interested, but this was a minority.

**Wilkins:**

You mean the students were selected really for people who were doing a degree for vocational purposes.

**Bohm:**

Yes. They get better job.

**Wilkins:**

Whereas, ordinary universities would have people just drifting up there to get a wider education.

**Bohm:**

Meanwhile, I was reading more and more of Krishnamurti getting a hold of more of his books and meeting him, say once a year when I came to London listening to his talks.

**Wilkins:**

That was before Brockwood [?]?

**Bohm:**

Yes. What else was I doing? I do not know. I was developing the ideas. And I did not have a lot to work, see Basil Hiley had just come, for the first year he did not come because he was ill. He came the same as I did. Then, after that, I was?

**Wilkins:**

He is getting here, isn't he?

**Bohm:**

Yes. I became slowly acquainted with him, but it was a slow process. I had one or two students, but they were not exceptional.

**Wilkins:**

Did Basil come as a lecturer or?

**Bohm:**

Yes, as a senior. I do not know exactly when.

**Wilkins:**

A member of staff.

**Bohm:**

A member of staff.

**Wilkins:**

He did his Ph.D. here.

**Bohm:**

That is right. I had a few students and we worked on various things. I do not think any compared with Aharonov, Carmi or Pines for that matter.

**Wilkins:**

Where did the students from come?

**Bohm:**

They came largely from Bizkbeck itself.

**Wilkins:**

I see. There were students who taken a physics degree and then stayed to do a Ph.D.

**Bohm:**

Yes. I recall I was beginning to get a bit depressed about the whole subject. I did seem that there was

very little scope in Bizkbeck for doing much and the students were not all that good. And I could not find any contact here and everybody here was interested in, what they were doing then was group theory and working out long tables in groups and everybody was very excited about it. It seemed that elementary particle physics was just sort of working out that stuff.

**Wilkins:**

You mean it was groups then and strings now or?

**Bohm:**

Yes. They had just about began to, I think they had worked out this  $SU_3$  group and people got excited and everybody was giving lectures about it and doing long, long tables of groups. On the whole, I could not get very interested. I remember once giving a talk on my own ideas in, I cannot remember what they were now anymore, but in Imperial College. It was not Salon [?]. Who was the fellow who Matthews. He could not quite see the point of it, but he said, "Maybe you are more interested in mathematics than in physics." I was trying to develop something.

**Wilkins:**

I see.

**Bohm:**

I could not see the point of what they were doing and they could not see the point of what I was doing. I kept on, but I was getting a bit discouraged and feeling, really getting nowhere. I could see more and more when I talk with people that there were more people who were trying to use physics as a way of getting money or power. That whole element seemed to be building up more. I recall that I was reading Krishnamurti and for a while that seemed to be very helpful, but there seemed to reach an end of what you could do with this reading. I already felt that it did not; it became rather abstract after a while.

**Wilkins:**

What? Krishnamurti?

**Bohm:**

Reading it.



**Wilkins:**

Reading it.

**Bohm:**

I did meet him once a year and it became much more alive when I talked with him. We had some very good talks in those days about all sort of things, including universal mind.

**Wilkins:**

You mean as a kind of personality, he was somehow seen to be an expression of his idea as sort of in practice, so to speak?

**Bohm:**

Yes. That is right.

**Wilkins:**

Living [???].

**Bohm:**

That's right. It was called living. I think I had sort of picked up the idea that perhaps there could be a direct awareness of this universal mind or universal

ground, whatever you want to call it. Maybe Krishnamurti was in that state. He seemed to claim that. Therefore, the insight he got there would not only be irrelevant and should be relevant and communicable, also perhaps even helpful in physics and perhaps the two would be in somewhere related to try to get an idea about matter which would be coherent with what he was saying about the mind. So, all those things were forming. When I saw him — We began to go to Switzerland Zannu [?], where he had set up gatherings every year where people would meet in a tent, a couple of thousand people. He would give talks and he had smaller discussion groups. I think all of that really helped to keep my energy up because afterward I found out my ideas in physics would flow much better. By talking only with physicists, I felt there was a sort of Lenin atmosphere as far as I was concerned. There was a failure of communication. They did not know what I was talking about. I could not really get interested in what they were talking about. It was sort of getting back to that period in Berkeley when I wanted to give up physics. If you remember my saying I did not know quite what to do. I was beginning to think that these questions that Krishnamurti raised were

more important than physics. I remember at one stage I decided that. I think that is the way things were going. At that stage, the communication with Krishnamurti was very easy and very good. It was very direct it seemed. I would see quite a bit of him when we went to Zannu. I had the feeling that I was really understanding this stuff. I had talked about with all sorts of people. It seemed as if I was learning all about doing something.

**Wilkins:**

You mean with Krishnamurti's sort of ideas generally? You might have a grasp for them and then you could somehow illuminate them further.

**Bohm:**

Yes, talk about them with other people who were interested. It became a very strong interest. I felt that he was calling for a transformation and mutation of consciousness. If we use this language I was using now, you could say that to end this show which conceals itself so that it becomes a show which takes on the quality of the center of existence through the mind would be in a different state, a new state which you cannot imagine now where everything would be

quite different and where these problems we now have would be left behind. So, that was the sort of thing I was thinking about.

**Wilkins:**

But incidentally, I mean you didn't really find, did you very much, that in the other people who were — Did you find much the other people who were going there that you did not Krishnamurti stand out as being rather unique, that the other people [inaudible].

**Bohm:**

There were number of people — In the early days, I used to talk with a lot of people. There was a vivid interest, which made it interesting.

**Wilkins:**

They had an interest, but I mean, they did not have all that much to contribute, did they, in the sense that Krishnamurti did?

**Bohm:**

No. That was one of the points that there was a strong interest so that they would contribute something.

**Wilkins:**

You mean just sort of people being interested in a way [inaudible].

**Bohm:**

Well, they also commented and said things. They understood in their own way. It was a contribution. It was not at the level of Krishnamurti.

**Wilkins:**

[???] with a pretty big cap.

**Bohm:**

Yes. But anyway, during that period, I was quite happy with the whole thing. I think it was one of the things that enabled me to keep going because it seemed pretty dead in this place I got to. As the idea I thought of — It was not Bizkbeck which had fault, because Bizkbeck had the advantage for me in that it

was a very easy going atmosphere and I could do what I like, whereas, if I went to another place, there would have been pressure to work on their stuff.

**Wilkins:**

Yes, you mean in Imperial College you would have found this very strong atmosphere hanging all around the place?

**Bohm:**

Yes. There was not point in my applying to another place, because it was not my problem. My problem was that what they were doing.

**Wilkins:**

The problem of physics as a whole.

**Bohm:**

It did not interest me. I was very fascinated with physics, but I felt that the way it was going, I had no sympathy with it; and the way I wanted it to go, they had no sympathy. So I still thought that maybe by bringing mathematics and physics together they would get interested. Events were to prove that was no so.

**Wilkins:**

You mean you did not find any physicists at that time who had sort of broader and deeper philosophical interests, like sort of Bohr and things like that? People just were not around?

**Bohm:**

No. Bernal was about the broadest, but he was not very much in my line. Bernal was quite interested in what I had to say, actually.

**Wilkins:**

I somehow feel that there was all that much depths of understanding there.

**Bohm:**

He stood out far above most of the others.

**Wilkins:**

He certainly had an extraordinary sort of liveliness and a broad interest. That is true.

**Bohm:**

His mind was very lively.

**Wilkins:**

I was an undergraduate at Cambridge when he was there and I found him an extremely inspiring person. I saw quite a bit of him from time to time. During the war, too and after the war. I think what is final — I am not very good to talk about what is final evaluation of people. There is not a sort of pleasant way of putting it, but I think that he had a terribly inspiring thing, pre-war and early war which I think somehow wore thin later on and I do not know that he had anything like the sort of depth of someone like Bohr to him.

**Bohm:**

Bohr had become fairly rigid by the time I met him anyway. Peterson was saying he was just crossing the T's and dotting the I's as an [???]. He kept on doing.

**Wilkins:**

Yes.



**Bohm:**

He thought that maybe if I could suggest some new idea, it would put a ten-year lease of life on board.

**Wilkins:**

Incidentally, there is a new newspaper called The Scientist and a one page article by Neville Mott and how he went to work with Bohr. It brought a thing out which I had never taken in properly from previous reading. Apparently, he said extraordinary thing was about the time we spend around discussing everything. He went on and on and on and on.

**Bohm:**

Yes, well Bohr did. The point is they talked and talked and talked about all sorts of things.

**Wilkins:**

Apparently, he found this extremely stimulating.

**Bohm:**

Yes, well people do not talk. That is what I felt that we just got to be talking with no particular purpose.

## **Wilkins:**

Some kind of sort of open sort of process going on there, which?

## **Bohm:**

The more modern atmosphere is against it because everybody is thinking about his status and his job. People are even getting a bit afraid to talk, to share their ideas. I remember when I got back to Europe from Israel, I came in the summer of '56, and I met this fellow, George Yvick [?] whom I had known fairly well in America. He began to talk about my ideas and he took me aside one day and said, "You know, you better not talk so freely about your ideas, that people will steal them." The point is that the people became more interested in using ideas to get ahead to get ahead and to gain advantages. They were not sort of fascinated by the ideas themselves, just absorbed in them. They began to say, "This is the way I can get a job and get ahead and make it security and win a Nobel Prize and whatever." The atmosphere was not that free anymore. When I talked with Einstein, you could feel that he; you almost forgot that he was Einstein. You say here are

just two people talking. It is not to say who is he and where is he going? What is he going to get? ... and all that. That is how I felt with Krishnamurti when I first met him.

### **Wilkins:**

I was thinking there is something which sort of transcends or the personal concerns which was bigger than them, so to speak.

### **Bohm:**

During this period which I found somewhat depressing as far as physics was concerned, we got a student, Donald Schumacher, was quite brilliant. He came from America, but he was not very stable mentally. He took a great interest in Niels Bohr. He really studied Niels Bohr and he had some insights into Niels Bohr which, Bohr is exceptionally hard to understand, and as I said, I think I wrote a book Quantum Mechanics which I thought was on Bohr's philosophy, but it probably was not. It was a bit closer to Pauli's philosophy. Pauli was regarded as one of the architects of the Copenhagen Interpretation, and yet you can see big differences between him and Bohr. I had come out with

something which Pauli like a great deal and Bohr never commented on.

**Wilkins:**

You mean when you sent it to them?

**Bohm:**

Yes. I can see now that Bohr could not have said anything to me, because it would have been very embarrassing to him to say that I praise Bohr so highly, and he would have to say that I had it all wrong. But Pauli liked it, because my ideas are really much closer to Pauli than to Bohr. The point is, I had not really understood Bohr, but I had sort of seen him the way I wanted to see him. Because he was so hard to understand, I sort of began to read my own view in there. This fellow Schumacher had some insight which made it much more clear what Bohr was about. What he said could be summed up by saying that the form of the experimental conditions and the meaning or content of the results are a whole, not further analyzable. This question of the observer and the observed, which is fascinated by quantum mechanics, is very hard to put consistently without confusion. You may say there is

supposed to be an indivisible quantum uniting the observing equipment and what is observed.

Therefore, if it indivisible, you cannot distinguish them, because any distinction between them would cut that quantum, if you cut the quantum, you have changed the situation. Imagine here the two together, one whole. Between them Bohr drew sort of a dotted line saying a distinction, but across that distinction is this indivisible quantum which cannot be distinguished. So, the distinction, he said, is only logical and not real.

### **Wilkins:**

The dotted line, not a whole line.

### **Bohm:**

A real line, yes. In other words, it is like form and content. Therefore, the point is now that what Bohr emphasized the whole phenomenon. He said, “The phenomenon cannot be discussed apart from the whole set of experimental conditions.” The experiment result, the meaning of the experimental result cannot be separated from those conditions. Therefore, different conditions have a different meaning. That is with complementary. The

conditions for measuring momentum mean one thing. The conditions for measuring position cause the same result and mean something else, the same spot of the observed. But the two conditions are not compatible. That is the meaning of complementarity. It became clear that Bohr said the phenomenon was not analyzable. The phenomenon is the appearance. Essentially saying nothing can be said about the essence underlying the appearance. The whole point of explanation is then to find the essence underlying the appearance. He is saying that there is not any or you can say nothing about it. Therefore, it would have been a very repellant philosophy to me had I understood that in the early days. To say we have nothing but the appearance and we have a mathematical algorithm which enables us to compute the probability of a certain phenomenon.

**Wilkins:**

I think you said another time that he denied there was any physical reality.

**Bohm:**

Looking at it more carefully, he did not deny there is reality, but he denied you could say anything about

it. Now, Pauli did not do that. He said quite a bit about it. He said that the mind is involved, the mind of the observer is involved in that reality. I would not have gone on with Pauli that way, but there were a great many other points about Pauli I probably would have gone on. I said quantum properties in my book, I said in my book quantum properties are potentialities which I realized according to the experimental conditions. I was saying something more about reality than Bohr would want to say, would think proper to say. Is that clear? If I say it is a potentiality Bohr does not want to say anything. He said, “I only discuss the phenomenon.” I say, “Underlying the phenomenon is a reality of out which has the potentiality for producing various phenomenon.”

**Wilkins:**

You are saying?

**Bohm:**

Yes. Pauli is saying it, too, and so is Heisenberg. But everybody says Bohr, Heisenberg, and Pauli are saying the same thing, but they are not.

**Wilkins:**

So, Bohr did not like to be trying to grasp this underlying reality?

**Bohm:**

No, he did not want to say anything about it.

**Wilkins:**

He was essentially elusive?

**Bohm:**

Yes, whereas, Pauli said it is pretty elusive too, but if there is something you can say, Heisenberg, right? So, that was more along my line too to say there is something you can say. On the other hand, I understood from Schumacher what Bohr was saying that there is nothing you can say. When you have described the phenomenon, you had described all that can be said.

**Wilkins:**

It does seem to me to illustrate the extreme subtlety of these notions. I think I am beginning to understand a little bit more about that peculiar thing they say that



Bohr never wrote his own papers. He sat around with a whole group of people talking them and got them to write them. The whole group wrote them. Presumably, this is something to do with the whole subtlety of the operation.

**Bohm:**

Yes, he had to find out how the language would communicate.

**Wilkins:**

Otherwise, you would think, “Why on Earth did he not get on and write his own paper?”

**Bohm:**

His problem was to communicate in a way that he felt would not distort, so he had to distort the subtlety in order to not over simplify.

**Wilkins:**

You mean if there was not this talk going backwards and forwards, than he could not?

## Interview Session - 8

**Bohm:**

We were discussing some of the early period when I was in London, you know, last week.

**Wilkins:**

In London?

**Bohm:**

Yes. You remember discussing Bohr. We got as far as discussing ideas about Bohr, about what Bohr was doing and the philosophy of Bohr, the wholeness which was in Bohr. You don't remember my student, Schumacher?

**Wilkins:**

Yes, I remember now. You were saying about Schumacher and the complementarity or something and what he precisely meant by this. Yes.

**Bohm:**

Yes. Well now it occurred to me that we ought to go back; I left out a few things. Even back to Bristol.

The last year or so in Bristol I got in contact with somebody in the math department and we discussed a lot of algebraic topology. I attended a seminar of his.

**Wilkins:**

In your last year there?

**Bohm:**

Yes. I can't remember the man's name. But now this I felt was very relevant because I felt it provided an analogy to quantum mechanics. The basic idea was that space was broken up into simplicies that might be called squares or triangles, to triangulate it into finite areas. And then when you carry out integrations of functions over the space you only specify the inter grow and not the function and detail. The idea of integrating functions over small areas. These were called P-sets. Now it was shown that those integrals of functions, which form a discrete set of numbers, have a property that the boundaries can be represented by discrete operations of matrices. Therefore a lot of equations of physics, such as Laplace's Equation and Maxwell's Equation, could be looked at as just specifying some integrals

of various functions over area of certain simplicities and their boundaries. For example, in they have the basic simplex triangle, the boundary would be the three lines. The boundaries of each of those lines are two points and so on. We have integrals over these simplicities and expressed in terms of the intricate functions and the boundaries. You get sort of discreet matrix relationships, which look a lot like quantum mechanics. Now this seemed interesting because I wanted to find — See, I wasn't thinking about Einstein who had said, "Instead of regarding gravity as a form of mechanics," he said, "gravity is a manifestation of geometry." Is that clear any?

**Wilkins:**

I think so, yes. You mean something in the material world, which caused one to something in the mental world.

**Bohm:**

No. He says that properties of space — or instead of Euclidean geometry, which is usual we expect, if it were non-Euclidean and curved space, this would be an explanation of gravity. That an object moving by its own inertia in what is the nearest possible thing

to a straight line would follow a curve path, which would describe the effects that we ordinarily attribute of gravity. For example, if you take a sphere, geodesic is the nearest to a straight line, suppose this spirit has an irregular surface, then the geodesic will all sorts of wiggles in it. One idea is to say that there are forces that make it wiggle. The other says it's just following the nearest it can to a straight line because the surface is irregular you get these wiggles. Now it doesn't include a time as part of the space and time together. And that way you have a trajectory, and that there product or planet is now following the geodesic as the geometry is modified by matter. Now therefore, the idea is unite properties of matter, the dynamical properties of matter with the properties of space and time. That was his basic idea. Now I said, "Well that's fine for classical physics, but quantum mechanics is very hard to unite because it's so different." See first of all, you have the fact that you have sort of discreet movements rather than continuous. Secondly, it's probabilistic and not deterministic. And thirdly, it has all sorts of non-local features. Whereas you could say that the geometry does not have any of this. It's deterministic. It's continuous. It's local. But

if you want it to regard quantum mechanics as a manifestation of the properties of space it looks as if we're blocked. Then we seem to have a contradiction that we say we quantum mechanics of space on the one hand, continuous and so on. In quantum mechanics quite the opposite. Somehow it has to be injected into space and we cannot make any sense of it. So I said, "Suppose we regard quantum mechanics as an indicator of the properties of space, as we could regarding gravity as an indicator of properties of space. But then we need a new mathematics. We need to describe space in mathematics similar to that of quantum theory." I always thought this algebraic topology was beginning to do that. First of all, it described all sorts of relations by matrices, which were discrete among simplicities that are broken up into discrete bits. And secondly, it was open to transformation similar to quantum mechanics, a linear transformation among all those bits, which was exactly the same as what was called unitary transformation in quantum mechanics, that the wave functioning was subject of that transformation. That was one of the most basic principles quantum mechanics, which is behind what is called the Principle of Linear Superposition. So I

said, “It looks as if algebraic topology might have in it something similar to quantum mechanics. And you might eventually hope that by starting with a discreet description of space, starting with abstract simplicities and boundary and neighborhood relations described by matrices, you could get to space.” For example, if you take a lot of triangles, take the  $n$ th triangle and we say let me out all the lines that are in this whole way of triangulating the space. Then you say which of these lines are on the boundary of the which triangle? That determines a matrix, which is one if it’s on zero if it’s off. Then you could also determine neighborhood relations saying which simplex is the neighbor of which. Which is one if it’s a neighbor to zero or otherwise and so on. So you could say in principle the properties of space are determined by boundary and neighborhood relations at least in our metrical property. Quantum mechanics has to do with those rather than with the metrical properties, which are further refinement, the measurement, you know, the length and so on. So that was why I was interested in this algebraic topology.

**Wilkins:**

You mean a metrical thing —

**Bohm:**

It would come in a little bit later. That comes in actually in the —

**Wilkins:**

I mean do you have continuity doesn't it?

**Bohm:**

No, not necessarily, because it turned out that to each set of simplicities there's a dual set and that metric relates the simplex in as a dual. Metric is implicit in the relation two sets of simplicities. Let me give you an example. Suppose you break up space into squares, two dimensional space into squares, tessellate it, right. You can form a set dual simplicities by putting a point in the middle of each square and in the middle of each line and so on and draw lines. Then you get another set of squares, which sort of half overlaps the first. That's called a dual set. Now it turns out formally that the role of



metric is covered in the topology by the relationship between a simplex and its dual. Therefore there's a topological meaning to metric, and then its measurement meaning comes out in a later wave, somewhat more indirectly.

**Wilkins:**

Well, go on. I can't really grasp all this, but you better go ahead.

**Bohm:**

I don't know much of this I could put in the book then.

**Wilkins:**

You what?

**Bohm:**

How much would I put in the book?

**Wilkins:**

I don't know. I think this is a bit —

**Bohm:**

You grasp the tessellation of the whole space by trying that and the simple relationships of boundary and so on. Then I could just say in the book that there's another relationship called dual, which contains the metric. We won't go into it now.

**Wilkins:**

Well, I think if you want to use the term “the metric,” then you need to explain what you mean by “the metric.”

**Bohm:**

What is meant by perpendicular? The metric determines — There are two functions of metric. One is to determine angles and the other is to determine length. Now angles are effectively determined once you determine what is the perpendicular, and then once you do that you can then divide up angles. Now see if we take this dual simplex, it determines the perpendicular simplex in a way which does not refer to the ordinary properties of space. It just says put another point inside the

square and another point inside the midpoint of each line, then the lines which connect them are by definition the perpendicular. If you start that way as a midpoint you'll get the usual perpendicular, but then you can then proceed to take that as the definition.

**Wilkins:**

I think this should do all right. It's a little bit like a book that I was reading about in Harrison's text where they use all sorts of terms like interest. Interest is used in different ways in these contexts of money and regulation. So that I think if you explain it, it should be all right.

**Bohm:**

The idea which I had by the time I got to London was that somehow topology would be a way into treating quantum mechanics in the same way that Einstein treated the ordinary metrical property, continuous properties of space, the curvature and all of that. Therefore we could eventually then get to new laws. Just as Einstein found new laws, you know, once he was able to treat curved space as the event he came to new kinds of laws and similarly

new kinds of laws could be arrived at, which would be beyond even quantum mechanics if you took this as a base. That was an idea which was interesting to me, and essentially it was the germ of the implicate order. Because this algebraic topology contained what I called an explosive transformation, that each simplex was exploded into all the others. Therefore, that was essentially the implicate order that each simplex was as it were unfolded into all the others.

**Wilkins:**

Have you got that in your Implicate Order book?

**Bohm:**

No.

**Wilkins:**

I didn't think I've seen it there.

**Bohm:**

No. But that was already the mathematical term of the implicate order. I didn't think of it in those terms then, but I felt it.

**Wilkins:**

It seems to me that these ideas can be very helpful, because in the Implicate Order book you use various analogies like holograms and the deep thoughts in the glossary. And then I think you point that of course in certain respects none of these analogies holds up completely.

**Bohm:**

No.

**Wilkins:**

But if you don't take it too far, each of them helps one to comprehend what is meant by the basic ideas. But I think it is further ideas like the one you're mentioning I would have thought would be helpful.

**Bohm:**

Another thing that I didn't mention was that just about the time before I was leaving —

**Wilkins:**

Wait a minute. Can I get clear?

**Bohm:**

Yes.

**Wilkins:**

You've got those thoughts when?

**Bohm:**

When I was leaving Bristol the first year or so in London.

**Wilkins:**

But did you then leave them on one side for some time and then seeing the significance in relation to implicate order later on?

**Bohm:**

Yes. These would be a part of my idea about this underlying cosmology and world view of saying that we would — I had the idea that flowing movement as basic and the forms would appear out of it. But then the idea was that space and time itself must eventually appear out of it that the flow of

movement would be in these forms. It tied up at some questions in art somehow.

**Wilkins:**

I mean Heraclitus was more or less saying everything is flowing movement, all is change.

**Bohm:**

All this change, the ground of everything has change. Let's put it that way. As movement. And then the way I think Aristotle sort of backed that up insofar as he talked of the potential to the actual — the potentiality was potentiality for change in Aristotle's view.

**Wilkins:**

You mean everything is moving to find its right place?

**Bohm:**

Also that in so far as he says, "Everything has potential for being other." That was a very dynamic view. And also that the potential was not just the potential for a fixed form, but the potential was a potential to change things.

**Wilkins:**

All this is an interesting point. I suppose the whole organismic notion of Aristotle was holistic too. But Democritus says everything is atoms in motion.

**Bohm:**

But then that was not fully Heraclitian because the atoms were fixed beings.

**Wilkins:**

Yes, exactly. Well at least he was saying that they're not moving.

**Bohm:**

He was sort of in a compromised position. He said, "That the problem was what is the nature of being in motion." Now Parmenides had said, "All is being. There is no nonbeing. There is no motion." And that seemed logical, but it made no sense. Now then Heraclitus had said all is flux, though they're to extremes. Now then Democritus tried to solve this problem. What is motion? Zeno made the paradox, then, what is motion? How can there be motion? If



an object moves from one time to the next, at each moment it's just there. There's no motion. The only way you can discuss motion is by comparing a point that is to a point that was. But then that makes no sense to compare what is to what is not to discuss the property of what is. Democritus was trying to solve Zeno's paradox.

**Wilkins:**

Is that commonly —

**Bohm:**

I don't know. I read it somewhere.

**Wilkins:**

It's commonly recognized.

**Bohm:**

Yes. His solution was brought in by bringing in the atoms, which are permanent beings, and the void, which was nothing. It combined being and nothing literally. He said, "The nothingness of the void made room for the atoms to move." Whereas in platonism of Parmenides left no room for anything to move around. Therefore these atoms could move and in

their motion they could explain the various life scale objects, you know, their properties.

**Wilkins:**

If you take molecular biology, I mean they're saying everything is moving. This is the basis of their sort of modern way of Darwinian evolution and direction. All these are all sort of bobbing about [??] —

**Bohm:**

Yes, but it's not the same as Heraclitus because in Heraclitus even the very units are not given.

**Wilkins:**

No, but it's more Democritus.

**Bohm:**

Democritus. Modern physics tends to move towards Democritus, though quantum mechanics makes Democritus extremely hard to use.

**Wilkins:**

Well, I think the idea that everything is possibly in motion is an essential part of the whole sort of molecular biological idea.

**Bohm:**

Except to say that the fundamental units are not regarded as — That is, to use the word flux of everything flows means that there is no fixed quality at all. Democritus did not say that everything flows. The basic beings, the atoms, did not flow. They merely moved translated through space. The motion was reduced to mechanical motion.

**Wilkins:**

Yes. They had fixed shapes, too.

**Bohm:**

Fixed shapes and fixed qualities. In Heraclitus everything flows, but in Democritus there is no flow in a way.

**Wilkins:**

I agree entirely. I just hadn't seen this point about the connection between Democritus and Heraclitus.

**Bohm:**

Yes. And he is trying to also put himself between Parmenides who said only being is. Because the atoms were really each one was a being just as Parmenides would've said, eternal and so on. He really combined Parmenides and Heraclitus. It's a sort of an uneasy mixture, which momentarily solves the problem.

**Wilkins:**

I can't see any respect in which molecular biology doesn't cause form to Democritus.

**Bohm:**

No at present it doesn't. Quantum mechanics does not really fit Democritus, but molecular biology it hardly takes account of quantum mechanics.

**Wilkins:**

Exactly. It hardly takes account.

**Bohm:**

And it makes the task of assumption that it cannot matter very much. Once you've taken into account the chemical properties predicted by quantum mechanics.

**Wilkins:**

Yes. I think that the bonding between atoms can be regarded like the little hooks on Democritus, atoms and so on.

**Bohm:**

It's just says quantum mechanics is a nice way of working out those hooks.

**Wilkins:**

Incidentally, I don't know whether you've seen the work of Mason here in chemistry, but they worked out the spin in the nucleus can give rise to small sort of differences of [??]ality of the energy of different [??] forms. So this would account for the left-handed amino acids. Now this sort of is the first link between the new subatomic level and the molecular.

But it's not obvious to me that this sort of is eroding the basic assumption [???].

**Bohm:**

No, it doesn't. It's using the particles and these are smaller ones. It doesn't really —

**Wilkins:**

Yes, it's certainly extending the thing down to another level. But I suppose what you can say is that of course once you get down to subatomic level and everything's getting sort of very vague. But I don't think this still doesn't undermine the molecular biology thing, does it?

**Bohm:**

No. Unless you take quantum mechanics very seriously, which molecular biologists generally don't know anything about quantum mechanics. They couldn't possibly take and fix [?] things.

**Wilkins:**

I sort of wonder if there is any sort of a little chink in the armor coming in through that Mason point? I don't see it myself.

**Bohm:**

No, I don't think so. Because thinking of these smaller particles as essentially similar to the larger ones. There's no reason why the Democritean atoms couldn't be made of smaller atoms.

**Wilkins:**

And there's no reason why these little fixed atoms shouldn't fixed that and shouldn't have fixed attributes like spin tossing the atomic particles. It doesn't seem to me to undermine anything.

**Bohm:**

The only way of undermining is to bring in the concepts of quantum mechanics directly, and molecular biology is much too crude as to yet touch that.

**Wilkins:**

But how would you do it?

**Bohm:**

You're dealing with large aggregates looked at very crudely. It's the only very, very fine measurements

to show up for example interference measurements for the electrons show up quantum mechanics, but to have interference with such large objects would be far beyond the present technical capacity.

**Wilkins:**

But do you mean this is the problem of trying to predict the way structure of larger molecules? They're not the same?

**Bohm:**

Well, no. We don't know how much quantum mechanics will come in there, but I'm just saying that the quantum mechanical properties of matter show up only very subtly with such large molecules. And molecular biology is not yet subtle enough to bring that up. Just as it took hundreds of years before some of the atomic properties would show up in ordinary measurements. Vast refinements of technology were needed.

**Wilkins:**

E. Schrödinger I have the idea about mutations, sort of things jumping from one being —



**Bohm:**

But we don't need quantum mechanics for that. It could be produced by thermal motion and so on.

**Wilkins:**

Yes. There's nothing essentially [??] tacit [?] about that.

**Bohm:**

No. I think that quantum mechanics involves subtleties that have not been touched by molecular biology. It may take a very long time before they could do such.

**Wilkins:**

You mean if something is broken apart by thermal motion, this can be done on a purely classical.

**Bohm:**

Yes.

**Wilkins:**

You mean you don't have to bring in tunneling for normal [??] or anything like that?

**Bohm:**

No. It could happen that way, but it isn't necessary. For example, radiation can do it. You can think of it as just being hit by billiard balls. Also breaking chemical bonds could do it.

**Wilkins:**

I've sort of wondered occasionally how much people have thought about this thing about molecular biology and quantum mechanics. Normally people don't think about it at all.

**Bohm:**

No. I think one reason is that it's a long way before one can see any way in which quantum mechanics would make a difference in the kind of things they're studying today. If you assume the sort of thing they're studying today is all that counts then it will never make a difference, but that may not hold.

**Wilkins:**

I think the corollarity business was a very sort of sensitive thing.

**Bohm:**

Yes, but it's not a very fundamental point.

**Wilkins:**

But as you say, this doesn't need a quantum —

**Bohm:**

Beyond the fact that quantum mechanics is used to discuss, then you can think about it as just another property as it is now.

**Wilkins:**

What I was getting at was whether it's left or right, it's a very sensitive thing, which is being picked out presumably by, they would by natural selection process. And a very tiny minute energy difference in the end would turn one way and not the other. But whether there are any other phenomenon, which I suppose you might say that in evolutionary processes generally you might pick up very small differences after a while. Anyway, we'd better back to your —

## Bohm:

We're discussing now the properties of space. But another current which started toward the end of my period in Bristol was that my book, the book had just come out, *Causality and Chance in Modern Physics* where I discussed the meaning of causality and proposed this infinity of nature, which we've discussed. To say that — it was somewhat Hegelian, that in every context there is the necessary in the contingent. But what is necessary in one context may be a contingent in a broader one, and vice versa. What is contingent may be necessary, right? So we say that we have the interweaving of necessity and contingency on an infinite context with human beings always finitely from that. That was the basic view of reality I proposed, which left room for saying that there was essentially no limit on the thing, but there was no fixed limit on anything because the whole context was infinite. Now that book — there was an artist in London called Anthony Hill or was it Chelsea. He sent it off to another artist in America called Charles Biederman. He works in a place called Redwing, Minnesota. It's a very small town. They're a peculiar set of artists called the structuralists artists. I'll explain that

presently. But Biederman read this book and he was very interested in it. He wrote me a letter, we wrote both back and forth. We started a correspondence which lasted about seven or eight years, a very extensive correspondence, which covered many things that I'll have to discuss which effected the development of my idea. The first thing to remember is that Biederman, he sent me a long book called Art Is the Evolution of Visual Knowledge, and one of his books, a very thick book. And another book, The New Cézanne [?]. He was very interested in Cézanne. Let me explain his views on art. He called himself a structurist. There was a small structurist school, a few here in England and a few in America. Anthony Hill was one of them. They didn't really all agree with each other at all. But the basic idea, you have to consider the evolution of art to understand it. He was saying that art has basically two components. One is it began as a form of mimesis, of imitating the forms of nature, the forms that could be seen. It had a function in society to make images and so on. In addition it had a creative aspect. These two are always in some uneasy tension. The point is that the major creativity in art, one possibility at that stage was the development of new means of

mimesis. The biggest steps in creativity. For example, perspective, what Leonardo did. Every great artist developed his own approach, every great artist. But there was constant improvement of mimesis so that by the early 19th Century, a French Realist, his paintings have reached a tremendous level of realism. Just about that time photography was invented, apparently partly by artists who were trying to — The artistic idea behind the invention of photography was to let light paint the picture. The early people who worked in photography were very much inspired by art, and they were even themselves artists. The idea was that light began to paint the picture. As photography developed, the mimetic function of art began to become less important. Anyway, the mimetic function had been carried so far that it could not go much further. It was reaching a kind of dead end. There was very little room for creativity in doing that. You could have gotten more and more detail and these people would've lost interest.

**Wilkins:**

Philosophically, this whole notion of copying nature is sort of quite unsound, isn't it?

**Bohm:**

Right. Well, no. People had two things. They had a creative aspect where they tried to say something different, and at the same time they had to produce images in imitating nature. Not only nature, but also forms of human beings or imagined forms in people's minds or whatever.

**Wilkins:**

But if you say that you're going to make copies of nature, this implies that there is some objective —

**Bohm:**

No. They're imitating the appearance of nature. That's all we're saying.

**Wilkins:**

But the appearance of nature were to depend very much on how they see it.

**Bohm:**

Yes, that's right. But nevertheless, given that people will eventually become quite proficient at it. You see whatever way they see it, and there won't be much room to go very much further except to develop new ways of seeing it. But that's something different. That's really what we're going to discuss.

**Wilkins:**

So they were quite clear, you mean, about the lack of objectivity and they —

**Bohm:**

It may or may not have been clear, but Biederman feels that's what more or less happened whether they were conscious of it or not. In fact some were and some weren't. But that was sort of the general milieu in which artists worked.

**Wilkins:**

I thought the general notion was that very often photography doesn't in any sense copy nature. And it sort of —



**Bohm:**

No. We're not trying to say it copied nature. The work copy is wrong. They're saying they're imitating — the artist imitates the appearance of nature. But now photography lets nature paint its own picture. That doesn't mean that nature isn't copying itself.

**Wilkins:**

Imitating the appearance.

**Bohm:**

Yes.

**Wilkins:**

So you say photography is doing what?

**Bohm:**

It's not doing that. It's letting nature paint its own picture.

**Wilkins:**

So it's nothing to do with her appearance, sort of [???] of appearance —

**Bohm:**

It will create a new appearance as it does that. It will be in a way in which nature appears through the camera. As it appears through our eyes, it can appear through the camera.

**Wilkins:**

I still don't understand this thing about so-called primitive people and not being able to recognize photographs.

**Bohm:**

That's because it is nature appearing in a form which they don't recognize. To them a person has two eyes. Now if you photograph him and he's got one eye, they say it's wrong.

**Wilkins:**

Maybe some of it has to do with the fact that the thing's on a sheet of paper or something.

**Bohm:**

Not necessarily that because they may not have even put things on paper. But their concept — the

appearance of a thing is very much connected with your concept of it as well.

**Wilkins:**

That's what I was getting at.

**Bohm:**

To these people the concept of a person is he's got two eyes and two hands and whatever. And if an image appears without these, it's the wrong image.

**Wilkins:**

Even if the image has two eyes and two hands, I thought they didn't recognize it.

**Bohm:**

They might if it were square on. Their point is the standard image might be square on or from a certain direction or whatever. It doesn't have the features. The image is quite different, photographic image, from the way people see things, and they have to learn a little bit to see it. They can probably learn fairly quickly how to see it.

**Wilkins:**

Maybe they don't see things from fixed positions anyway. They're always moving around also.

**Bohm:**

That's right, but they can fairly quickly learn how to interpret a photograph, I don't think. It wouldn't take them more than half an hour probably. I think, Ed, we have done that ourselves, but we've forgotten when it happened.

**Wilkins:**

I think people always talk this notion out as though it's a sort of fairly simple one, but I think it's not all that simple.

**Bohm:**

So, now the idea was that during the 19th century art was entering a period of crisis because traditionally people were expected to imitate the appearance of nature according to this conventions, what people thought was the appearance of nature. Artists had developed certain conventions and whoever didn't follow them was not thought to be producing a good

likeness. Even people like the English artists, mostly landscapes, Turner, he was innovating quite a bit. He was sort of breaking out of some of the conventions of appearance and going into light, the question of light as a basic part of the experience. So in the early days there was some innovation going on. As the century wore on the crisis got harder. What were artists to do? When the impressionists came, there was the first big change, the first really fundamental change that Monet began. The impressionists, each one were somewhat different. They weren't all the same. But they were sort of experimenting with changing the meaning of life. Now Monet thought of making little elements of primary color and building everything out of that. When you get close to it you don't see very much. As you step back suddenly it seems you see a whole space with people and objects, three dimensions and all sorts of things. What Biederman said that what Monet was doing was recreating the order of space through the properties of primary spots of color, primary elements of color, small elements. Now I just sort of anticipate here. This was a little bit like the simplicities which I talked about breaking up space into simplicities. You could imagine putting colors

on these and trying to build some images out of them. Colors of varying intensity. When I thought of Biederman, I saw a relationship in his talking about and what I've been interested in, which I want to pursue a little bit later. At first Monet was regarded as really absurd and ridiculous and not art at all. Only later did people accept Monet and the other impressionists as artists. But they had already made a radical questioning of the notion of order that instead of trying to imitate by little very fine gradations of paint, they used these small blobs of color. Or brush strokes or whatever form they took. It was the pointillists who had little points of color.

### **Wilkins:**

I remember one of the main ideas was that the whole thing was brighter because you didn't mix all of the pigments up together.

### **Bohm:**

It made a bright thing, but there was a whole new idea in there. Brightness was only a side issue. There was a new whole idea about what to do.

## **Wilkins:**

But presumably the fact that it was brighter encouraged them a lot.

## **Bohm:**

It may have felt better and so on, it gave a lightness and brightness to it. But what was behind it was a whole new idea of what was involved. Now what Biederman says is this evolution went along. Monet eventually began to repeat himself and didn't get any further. But Cézanne went further. Cézanne essentially became interested in not so much in the question of order. Let's put it that previously artists have been interested in form, trying to imitate the appearance of form. This was the beginning. An artist was becoming interested in the order of space. These little spots of color had no meaning by themselves, and only the way they were arranged in order began to give meaning. It was not imitating the forms of nature, but they were sort of coming out of it when you stepped back. There was hardly any form visible when you got close. But this was really a radically new idea, much deeper than the periods of first sight.

**Wilkins:**

You mean this is distinct from the idea that you don't see the brushstrokes.

**Bohm:**

When you stand back you don't see the brushstrokes. If you get close up you'll see them. But when you stand back your attention, your consciousness is on the whole meaning of it, which is a three dimensional scene of all colors and shapes and whatnot. But none of those shapes has been imitated at all. Form appears as a property of order. Order in arrangement of the brushstrokes.

**Wilkins:**

You mean the direction of the brushstrokes is related to the form, whereas the —

**Bohm:**

The general power was in the brushstrokes and may have something to do with form, but the way things are arranged it's very hard — I thought to make a theory of an impressionists painting I that would



brought you to a mathematics close to the quantum mathematics.

**Wilkins:**

But I mean the arrangement of little points of color doesn't bear any direct relationship to the form.

**Bohm:**

No obvious relationship at all, especially if you think of it as three dimensional formulas, two dimensional surface.

**Wilkins:**

In that respect it's quite distinct from the brushstroke.

**Bohm:**

Yes. Cézanne went on further to the question of structure. According to the dictionary structure is the order, arrangement, connection, and organization of elements. These elements may be very abstract, like spots of color and so on. Not only order in arrangement, but we also have the way they're connected and the way they're organized in large areas. Cézanne tried to organize in terms of the

sphere, for example. He talked a lot about the sphere, making anything out of spheres and other elements. But it especially in his later paintings and [??] Victor in France, he could see all these things were sort of combining to make up planes that covered the whole thing and it was all organized. It was forming a structure. The point then is that therefore Cézanne not only questioned — he didn't just discuss order with regard to giving rise to form, but he went into the question of structure, which then began to dominate the local order. Like you've seen, as the order was now entering into the overall organization of structure.

### **Wilkins:**

His structure wasn't really an overall one.

### **Bohm:**

An overall one. See Monet, is not concerned with structure, but with an order which eventually gives you an impression of form. But here he is giving a whole structure. This was carried for to some extent by Picasso and Brach in cubism where they made them more abstract. But there was a limit to what they could do, too. They couldn't carry it very much

further. Eventually Mondrian carried it as far as he could by discussing just your metric structure, which was as he said, “You’re dealing with a plane and it tends to pull in three dimensions getting beyond the structure which belonged to that structure.” But then Mondrian, you couldn’t go any further than he did. Once he did that, what could you do? He’s saying now art with Mondrian had reached a crisis where it could not deal with by staying in the plane. He says it has to emerge from the plane into three dimensions in order to make a new step.

**Wilkins:**

Who said that?

**Bohm:**

Biederman. That’s what he called structure. As he said, “The emphasis was structure,” but Cézanne and Mondrian brought out the emphasis on structure, but structure couldn’t get any further without going into three dimensions. That was okay?

## **Wilkins:**

I don't know what they did about it.

## **Bohm:**

I'll explain that. So he said that the fact that artists did not face this crisis led to confusion. Some of them slipped back into the two dimensional image again like Picasso. It was not very clear what they were trying to do because they had already mastered all of that. There was nothing new and that they were just going over old ground in various combinations. They were not being very creative. What he said about structure was that you had to come out, but not in the form of sculpture, because sculpture was merely a three dimensional imitation of nature's form. It was not a structure. So he said structure is more abstract. So he began to produce structures. He says, you've got to begin simply and complicate it and develop it later. You can't begin with complex structures right away. You must learn. So he began with structures on a plane, just reliefs, little planes sticking out of a background plane, that were colored. He eventually got to make them out of aluminum, which was a machine —

## **Wilkins:**

These are three dimensional objects.

## **Bohm:**

These are three dimensional objects. The typical thing was that a sheet of aluminum has a base with a very rich, intense color, and then planes sticking out of it at right angles or planer elements, which are also very rich with color in different ways. He would only give a few planes either this way or this way. Sometimes they started off ranging instead parallel planes here and there with different colors. He wanted to combine color as a key element of structure. The question was how did he learn to do this. He had a theory of perception saying that art influences our way of looking at things. We're conditioned by past art. In other words, not only does the appearance depend upon past conventions, but how past artists has changed those conventions. He says he had to get free of the conditioning by past art to move into this new area. What he had to do was — he says previously people observed nature to imitate nature's form. Now he's saying he observed nature not to imitate nature's form, but to

observe nature's way of creating. That is, nature's creative process itself. Nature's way of creating not the [???] It's like if you think of the camera as nature painting it's picture in the camera, then you could say nature creates within human beings, but the human has to be receptive to this creativity.

**Wilkins:**

Whether it's nature creating or the human being doesn't matter because you regard this as all part of the whole system.

**Bohm:**

Yes. Then when you learn nature's way of creating, mode of creating then you create as nature does. Instead of imitating nature's form, what you do is you create as nature does. And he's saying nature creates by beginning with simple things and getting more and more complex. That's an example, right.

**Wilkins:**

I don't know. I mean is that always the case?

**Bohm:**

Well, that's what all the biologists are saying when they talk about evolution and so on as an example.

**Wilkins:**

Complex things also create by going down to simpler things.

**Bohm:**

It can work the other way, but naturally it can always — But I mean fundamentally complex things are rising out of simpler things is the idea.

**Wilkins:**

Certainly.

**Bohm:**

But then it's far more subtle than that. That's just a small example. Then he's saying you have to proceed slowly and not expect to produce tremendous things right away. It might take generations, just as art itself evolved only over thousands of years in the form we know. I mean earlier peoples made much simpler pictures and so

on. So that's why you started with these simple planes with color, and he's saying they're evolving. I think that he's had a number of exhibitions. I'm not sure which museum has done it. In a Metropolitan perhaps. One of Guggenheim's, they buy his stuff and put it on display. He's had some exhibitions here and there. He had one here in London some years ago, around '67.

**Wilkins:**

Yes. Of course I suppose it's a difficult point to say to what extent these intellectual ideas. Are they sort of directing me? The artistic creativity and to what extent the intellectual ideas of some of expression of some underlying sort of attitude towards the whole nature of art or something. I suppose it doesn't really matter.

**Bohm:**

No. In any case, artists are highly influenced by their intellectual ideas about what art is supposed to be and so on.



**Wilkins:**

I think all that I'm getting at is that one is obviously, as a sort of stacked questioned locked in one's mind is to the extent of how creative it's going to be. If it is too much based on how intellectual —

**Bohm:**

The question is how could somebody ever break out a whole frame work of character which has gone on for thousands of years.

**Wilkins:**

Yes. I think actually the proof of the pudding as to what he comes up with.

**Bohm:**

Yes. You'll have to see it. I haven't had much opportunity really to see it properly. My own feeling is it's not as much as he says it is, but it's interesting enough.

**Wilkins:**

Right. There's all sorts of people who are always going around having ideas about what they're doing wrong. So I suppose the —

**Bohm:**

But he claims that the perception of these things was nonverbal. In other words, that his feeling for the ending of art and so on was a nonverbal — He says it's almost like people would've described a mystical experience, a sudden change of perception. That it has a radical effect at one moment. That he became free of past conditioning in art. Suddenly he could see that it's a different way of seeing the whole of reality and not just art.

**Wilkins:**

Is this related to what you were saying about being now heroes in the modern world or something?

**Bohm:**

Right.

**Wilkins:**

I mean that created processes is coming to an end.

**Bohm:**

The created process within all of the traditional framework is coming to an end. The artists saw that first. I mean art is now in a crisis because of that. Biederman claimed that because most artists did not face this crisis they went into a very confused reaction, which has split up into countless fragments and has degenerated. It's mostly commercialism now. It's nothing like the kind of creative thing that it was during Monet and Cézanne and so on, Picasso, there aren't any people like that now.

**Wilkins:**

Just in my feeling, I'm not very interested in graphic arts now. I was just wondering whether you're really right about the graphic artists seeing this sort of end of the road.

**Bohm:**

They feel it, perhaps they feel it. They don't actually are not able to verbalize it, most of them, but they're sort of been brought up with this crisis.

**Wilkins:**

I was thinking about writers, too. Whether one of the writers is ahead of the others or not doesn't really matter, but I suppose you could say that probably that all types of artistic creativity are probably having some sort of feeling, I suppose. In music too.

**Bohm:**

Yes. I had a very long correspondence with Biederman about many topics, not just art, but science, politics, society. He had very broad interests. It eventually ended because he couldn't accept Krishnamurti of art. Once I told him about Krishnamurti, he said that it became clear that this was entirely against what he wanted to do.

**Wilkins:**

What was it he objected to about Krishnamurti?

**Bohm:**

He felt that Krishnamurti essentially denied the value of other things, including art, essentially saying that there were no value in it. He's saying that Krishnamurti rejects him or anything. I think it's true that Krishnamurti would. I remember even once giving Krishnamurti some catalogue of an exhibition with some of his stuff in it. Krishnamurti never said anything about it. I don't think he cared about it. But I think that this is sort of anticipating Krishnamurti, which whom we haven't discussed yet. But I think that Krishnamurti essentially ended up by saying nothing mattered, not science, not art, not anything else. Only this transformation he was talking about then. Biederman sensed that when I sent him the book.

**Wilkins:**

Krishnamurti has always been very interested in science and scientists, hasn't he?

**Bohm:**

Only for the sake that they would help the transformation. As soon as they don't go along he loses interest. He's not very interested in science itself. It might be a secondary interest at most. He doesn't feel that it will do anything really or that it matters very much. I mean, I even asked him once suppose we came to the end of science and art. He says, "Well, what of it?"

**Wilkins:**

I don't really see how you can separate science and art [???] of life. Say this is sort of an expression of it.

**Bohm:**

Yes, but I mean the way Biederman put it was that the most that Krishnamurti devalues most of the expressions of life in favor of his own particular approach.

**Wilkins:**

I feel sort of somewhat sympathetic toward Biederman. I just got a vague impression that [???]

wouldn't have had Indian dancing and music and all sorts of things.

**Bohm:**

Yes. But he doesn't mind it, but it doesn't mean very much to him. I'm saying that it's not really of a central concern.

**Wilkins:**

He's going to say it doesn't get you anywhere. It's true.

**Bohm:**

It doesn't get you to the main point, right.

**Wilkins:**

Whereas his transformation does.

**Bohm:**

That's what he's saying.

**Wilkins:**

Well, then you say that if you have a transformation what are you going to do afterwards?

## **Bohm:**

That's a question you could raise. He might argue that after that you could do whatever you like. It wouldn't matter. The first thing, you know, have your transformation. But I think we're sort of anticipating. Anyway, after a while eventually it broke down this correspondence over Krishnamurti. We can discuss that later after we discuss Krishnamurti a bit. Now the point is that I had developed a considerable interest in art. It started before Biederman. When I returned to Europe I became interested in art and going to museums and also as Sarah was interested in art, I became more interested. And so together especially we've gone to a lot of museums and talked about it. Looked at a lot of things. I found also Biederman was a bit narrow in his view of his art. He was very similar in Krishnamurti in that he kind of dismissed everything except himself.

## **Wilkins:**

That's a common characteristic.



**Bohm:**

He would admit scientists could be creative, but he felt art was the principle form of human creativity. For example, he felt that since Picasso had gone back toward representative art that there had been very little real creativity anywhere except his own. Which in a way you could say is true. But I remember once I tried to argue with him about Ruall [?]. I remember seeing it in the Edward J. Robinson collection, which was shown in London, a picture of a clown. This clown, I don't know if I've explained it to you before, it had a peculiar structure. It had spots, blotches of color really inside and outside, which corresponded to each other in position and they were complimentary colors.

**Wilkins:**

Was this Ruall's clown?

**Bohm:**

Well, it was one clown. He had a lot of clowns.

**Wilkins:**

He's made a lot of clowns.

**Bohm:**

Yes. He's done a lot of clowns, but this was one of them. I've never seen this one except in the Robinson collection.

**Wilkins:**

It was a bit like stained glass with heavy black lines and patches of color.

**Bohm:**

Yes. I don't remember the black lines. I can only remember the patches of color. This one didn't have very much in the way of black lines. It had patches of color moving out from a center giving a vague shape of a clown. But outside the clown were complimentary patches color on radii going in the same radius. As I was looking at this I began to move the eye from the inside patch to the corresponding outside patch. It would go back and forth. Suddenly there seemed a shift of perception where it seemed it had become higher dimensional in a sense that the clown was now in a vast current of energy, which was pouring out of him into the room and coming back around my head through me.

That all of the emotional feelings of the clown were pouring out of him through me. It seemed a tremendous shift of perception.

**Wilkins:**

So you had anyway some strong feeling, which was triggered off by looking at this painting.

**Bohm:**

Well, it wasn't only a feeling. It was a different structure in the sense that the picture was not separate from me. It was a feeling of the flowing movement going out of the clown, coming back around through me, and back into the clown.

**Wilkins:**

It was sort of a general feeling about this motion coming and going.

**Bohm:**

It was the same sort of shift that you get if you're in a stereoscope and you go from the two to the three dimensional view. It was a shift of structured perception.

**Wilkins:**

You mean it's like a whole sort of pattern turning inside out?

**Bohm:**

Yes. But the pattern was different. Previously it was a two dimensional picture with a —

**Wilkins:**

You sort of said it came out of nothing.

**Bohm:**

Yes. Also like the impressionist suddenly becomes a whole world if you step back. But this was more than a whole world just out there. It was a whole world which was flowing and came back to include [???

**Wilkins:**

I see.

**Bohm:**

I tried to write about that with Biederman, but he just said this was confused nonsense and he wouldn't listen to it.

**Wilkins:**

What did Sarah think about it?

**Bohm:**

She didn't see it that way. I don't know. I explained it to her later, because she wasn't there.

**Wilkins:**

Oh, she wasn't there.

**Bohm:**

She was with me, but somewhere else.

**Wilkins:**

I think I can see the sort of thing you mean, that the — I mean, you see something, which you didn't see before, which is —

**Bohm:**

Well, it was something that Biederman was talking about, which was a shift in perception. But he didn't want to acknowledge it in that case. I mean somehow he didn't feel that Ruall would be able to do anything like that. "It would just be confused," he said. I mean in this regard he was like Krishnamurti who doesn't acknowledge anybody else has ever done it either. As he says, "Sometimes I acknowledge the Buddha," but beyond that he's very reluctant.

**Wilkins:**

But isn't every sort of work of art to some extent is doing this kind of thing isn't it?

**Bohm:**

Doing what?

**Wilkins:**

Giving you some sort of change of perception. If it didn't you wouldn't want to look at it would you.

**Bohm:**

Yes, but I'm trying to say this was a very big change of perception.

**Wilkins:**

Particularly big.

**Bohm:**

It's as big as the shift from two to three dimensions.

**Wilkins:**

I suppose the thing about this feeling it was coming out and going around you and back again or something, why did Biederman object to that?

**Bohm:**

He just said that that's typical of Ruall's type of confusion. And he said, "If you wanted to really see that stuff you would see it much better in Cézanne."

**Wilkins:**

I've never understood why I didn't find Cézanne interesting. People are always going on about

Cézanne being so remarkable, and I never found it interesting.

**Bohm:**

Everybody sees things his own way. Anyway, that's some background to show where I was thinking. We discussed at great length the questions of order and form and structure, which are really crucial for understanding this problem of space that I was talking about. I wanted to derive space from something else, which was not space. That's essentially what Monet had done. That is he had derived the order of space from the order of elements of color, the arrangement inside. I wanted mathematically to do something similar. In fact, one could've thought that, suppose you had to make a theory of an impressionist's painting. What is it in the painting, which gives rise to this impression of form and space and so on? You would now discover many things. For example, it's known that the color value you get for any particular element depends on all the elements around it. And not only that, but their geometric form and then what they mean. Their impression of color is not just decided by the rays of light that are coming out of that little element. The



color impression of that element is determined by the meaning of the whole picture. I mean by all the, all sorts of features of the whole picture.

**Wilkins:**

Something in particular was the ones which you're fairly close to it.

**Bohm:**

Yes, but even further away can affect it. Also the space value of it whether it's in two or three dimensions and so on. Now that was something which appeared in quantum mechanics that you have what's called a hill-bred [?] space, multi-dimensional in which the value of any particular element would depend on other elements, which came in and produced a higher dimension. Suppose you have a large number of particles in quantum mechanics. Then the properties of any particle are dependent on all the others, some more than others, but really on the whole. Therefore you had a considerable analogy between this picture, the properties of the picture and the properties described in quantum mechanics. These properties are what are behind this non-locality that we've talking we've

talked about. To say the quality of any one element does not belong to itself alone. Therefore, I thought that if you had a good mathematician and he wanted to make a mathematical theory of an impressionist painting, he would have done something like what is done in quantum mechanics, but perhaps in a new way that would provide a new insight. It would've required getting in touch with some mathematicians just to try to do that. I mean I never found one that was really able to do it. He would've had to have broader interests. But then with Biederman we discussed questions of order and structure and creativity. These were all questions, which are relevant to my scientific interests and also my more general interests. The notion of a new order for space, this discreet order of simplicities and not the continuous order, and different notions of structure.

**Wilkins:**

Biederman was able to sort of put all his ideas clearly on paper?

**Bohm:**

He was very articulate. He was unusual for an artist.

**Wilkins:**

Yes. Because many artists I think are relatively inarticulate. I mean the only they can articulate is through their work isn't it.

**Bohm:**

Yes. He was very good at writing down all these things and he wrote a couple of books.

**Wilkins:**

By the way, did you see this chap, Dennis Potter on the television talking about his television series about the singing detective? Talking about people being articulate.

**Bohm:**

No.

**Wilkins:**

Maybe you were out of the country, but that was one of the most interesting television things for a very

long time. This, I don't know how many, it may have been six things in it television play or series. It was very interesting, seeing the playwrights sort of talking about how or putting these things in the works sort of related to his general way of thinking about things. And he was very articulate in that situation, which I think is often not the case.

**Bohm:**

That had a big effect on me. For some time I sort of went along with his theories although he sort of frustrated me a great deal about Ruall and about a few other questions where I disagreed. Because when he felt he was right he just simply stuck to it. He was like Krishnamurti again there. He wouldn't budge.

**Wilkins:**

Do you think he was like Bohr?

**Bohm:**

A bit like Bohr, too, yes.

**Wilkins:**

But I thought the difference with Bohr, at least when he was younger, was that he'd stick to things very hard, but if you beat him hard enough he was prepared to move.

**Bohm:**

Well, on fundamentals he never moved. He was not prepared to move.

**Wilkins:**

I suppose everything was —

**Bohm:**

That's Biederman too, but you see —

**Wilkins:**

It's a question of how quickly you come up against that wall.

**Bohm:**

Yes. But still it had a considerable effect on me, the whole thing. For a while I think I sort of accepted his views on art. Now I think they're interesting and

there's a lot of truth in them, but I don't fully necessarily accept them.

**Wilkins:**

But on the other hand they may provide useful sort of analogies and models in relation to your own ideas.

**Bohm:**

Yes. The important idea was that through your primary notion of order may come through visual perception. So that an important source of concepts would, I had the notion that if you could pay more attention to your visual perception then that would be; I think this was in agreement with Biederman, which would be an important source of new ways of thinking. To some extent this was along Einstein's line who said that he began with unspecifiable feelings and images and when there was something recurrent in them, that was the beginning of a concept. That the words came only later.

**Wilkins:**

Yes, that's true, but I think that Einstein wasn't saying that one should be cultivating these bodily sensations did he?

**Bohm:**

No.

**Wilkins:**

He was still presumably thinking — Well of course, we don't know what he did think about.

**Bohm:**

No. The idea was that if you would pay more attention to nature — and Biederman's idea was that his structurist art would enable him to do this because nature was very complex and difficult. But the essence was therein structurist started. He called it an analogy to visual music. He says music picks on a few notes and works out complex meanings from them. Now he says a few planes like this can work out a very subtle meaning. If you have such a structure standing on the wall as you walk around it or as the light changes and so on its meaning was

always changing. You would have to really have this structure, a few of them, and be able to live with it in order to see what it meant. The museum never shows it to you.

**Wilkins:**

Why? You mean you can't get all around it and you

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**Bohm:**

You don't see it in changing light and people are there interrupting you and so you can't really put your attention there.

**Wilkins:**

I think that that is a very sensitive point. But I suppose what Einstein might have said was that if you're thinking about your scientific problem, then it is desirable to take very seriously any, be particular responsive to any kind of visual notions or bodily something or other like that. I suppose that could be a clue to what Biederman was saying roughly.



**Bohm:**

Yes, but except Biederman would say that since he has already done this. It like say somebody who has produced quite a piece of music. If you listen to the music then you are able to pick up the essential plane, as if you have a whole bunch of sounds in nature you would have to devote a lot more attention and energy to getting anywhere. You would really have to work much more intensively. So he's saying that he felt that work along his line would be a kind of revolution in human consciousness, that it would really change the perception. By changing the way we saw things it would affect all the problems of humanity. He felt people were over attached to the word. Now in this he was affected by a fellow called Korzybski. I think also we'll have to bring him in.

**Wilkins:**

He would have to absolutely word.

**Bohm:**

Yes. There was a fellow called Alfred Korzybski who had been an American philosopher of the 1920s mostly, 1930s. Worked a lot on what's called

semantics or the study of meaning. Korzybski had written an extensive work called *Science and Sanity*, which Biederman recommended to me and I read it. There were a lot of things in it, but a few points I can probably say. One point is he had of saying whatever we say anything is, it isn't. It's more and it's different, that the word never covers everything. That we however tend to identify things with the meanings of our words, and this is the cause of the vast part of human problems. Because then the way we think about it is going to affect the way we see it. Therefore it was essential not to identify, but to say each particular phenomenon — Like he would say if you have the object now, the object next time, the object next time; it's not always the same, right. Or anything, like saying Mr. So and So now, Mr. So and So later, and So and So. And as you put suffixes, you know indices to indicate that it's a different occasion and therefore a different phenomenon and may have a different meaning. The idea is not to identify by a fixed concept, the meaning of the word. This is very important. Biederman felt that we haven't really used vision properly for the human psyche. He felt that vision was the most essential feature of the human psyche.

We had a lot of argument about that. He felt it hasn't been developed, but he felt it was the most essential feature. Even blind men, I argue with him about blind people who are born blind. But he said that their ability to do anything depending on the order that came by the communication with people who could see.

**Wilkins:**

It would be difficult to prove that wasn't so, anyway.

**Bohm:**

And he felt that if you would follow along the lines he's saying, this would be a revolution in human consciousness, to make it centered on sight rather than on words or sounds. He felt the visual capacities of the human brain had not really been utilized significantly, that they were mostly controlled by the tactile capacities. In other words, that when we see objects, we see them as we would feel them, that dominates it. But his view of structure was not to see it as you would feel it, but to see it first. All you have to do is to say that the object of something that would be touchable, but beyond that, the sense of touch would not play a big

role in his visual structures. But the dynamics of changing light and color and form and so on and space would be the thing.

**Wilkins:**

But then was he trying to say then that one should free one's self from all one's visual conditioning?

**Bohm:**

That's right. And he's saying that the artistic conditioning was a very big part of it. But he wanted to extend it. The visual conditioning by the tactile sense. He felt that would be a way to open the human mind up in new ways that wouldn't be so conditioned that would be free of many of the emotional troubles that are in the present approach. So in a way he was saying the same as Krishnamurti, that he had discovered something that would be a fundamental transformation of the human being, if you really pursued it.

**Wilkins:**

I'll say that it's always been something that's puzzled me a bit, because obviously you can never

be completely free of all your conditioning. Because you necessarily are [??] that enlarged [??] product.

**Bohm:**

No, he didn't say — You're not dominated by a conditioning. Krishnamurti says okay you're conditioned to all sorts of things like talk this way in a certain language and so on. But the conditioning that dominates you towards destructiveness and so on is what you have to be free of. There must be an intelligence beyond the conditioning.

**Wilkins:**

Yes. I mean there always is to some extent. But it seems to me that what he wanted was a much bigger sort of change of emphasis on the whole thing. I mean, if you are free of all conditioning well you couldn't do anything, could you?

**Bohm:**

I don't think he meant in exactly that sense.

**Wilkins:**

Yes. Well that's all right then. But I think possibly

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**Bohm:**

But there is a destructive kind of conditioning. See this is a matter that Korzybski and Biederman emphasized a lot. Korzybski criticized the use of allness in language to saying all black and people are so and so. That's typical with prejudice. If you say all conditioning you're getting in trouble. You have to qualify it.

**Wilkins:**

I mean very crudely what they meant was that your conditioning should show how be your servants and not only the masters.

**Bohm:**

Krishnamurti really meant that, but he had also he was conditioned to a kind of allness language from his early childhood which caused a lot of it to come out wrong. Perhaps he didn't realize the importance of that part of his conditioning and therefore he was still conditioned by it. Since he wanted to communicate and this stopped it, this was a serious point.

**Wilkins:**

I see what you're saying about Biederman's idea of freeing oneself in relation to one's visual perception. But you mean this was a sort of extension of what these other people had been doing in the early 19th Century and early 20th, but he wants to take it further you mean than they did.

**Bohm:**

Yes, much further. Also it was tied up with the idea my interests starting with Gurdjieff and Ouspensky and later Krishnamurti and being freed of other kinds of conditioning. So it's all sort of tied together. Being freed from the kind of conditioning that dominates you is the way I would put it. So that as you say, the conditioning serves you rather —

**Wilkins:**

Yes. It's having some degree of freedom in relation to more is everything. I mean, conditioning implies lack of freedom.

**Bohm:**

Well, that kind of conditioning. I mean some kind of conditioning may expand your freedom, if you can talk in the number of languages and so on. In a certain sense, right? But the kind of conditioning that compels you to certain patterns of behavior and certain prejudices and so on gets in your way. It impedes if you're that enslaved.

**Wilkins:**

In the language, presumably if you're going to use it creatively, there again you're making use of the conditioning.

**Bohm:**

It's not dominating you.

**Wilkins:**

I mean what I don't know about and you'll have to point smack to me is if you look at these ants and everything, all the stuff that socio-biologists study, I mean where is the freedom and creativity at the ant level?



**Bohm:**

It's hard to know. I mean that may not be a great deal.

**Wilkins:**

Yes. I think that these people tend to imply, who study them, is that there's nothing there. They would just be like programmed sort of robots.

**Bohm:**

They have no way of being sure of that. All they can say is they see certain things in which they —

**Wilkins:**

You mean you might have to study the — I mean you might say, well, human beings are 99% programmed robots, but eventually it's the 1% which makes the difference in us.

**Bohm:**

Say some being from Mars just coming to study human beings could easily conclude —

**Wilkins:**

Might tear [???] to see —

**Bohm:**

It'd take him a very long time before he saw something that wasn't programmed.

**Wilkins:**

Yes, which would say would be the essential human aspect. I just don't think it would be interesting if somebody looked at the ads from that point of view because at the moment they seem so dominated by this whole business about everything being determined by the genes that I don't imagine they're looking for anything else.

**Bohm:**

That's the point. You see the way of looking is conditioning. That's what Biederman is saying. Our visual perception is conditioned. And then Ouspensky and Gurdjieff and Krishnamurti, what you were saying our other kinds of thought and perception are conditioned. They raised the hope that you get free of this conditioning, whereas the people

you're talking about don't think anything. They think that that's all there is.

**Wilkins:**

Yes. In fact, they almost revel in it and say it's very important that we have to accept that this is the way things are. That's what Monos said. We've got to face this reality. Can you bring in some visual matter in relation to Biederman to test —

**Bohm:**

Well, I don't know. There is some catalogues I could ask for. He's still alive. He's getting very old.

**Wilkins:**

Yes. I think of course it is probably very difficult to —

**Bohm:**

It would be very costly to reproduce that stuff.

**Wilkins:**

What I was thinking more was if some of his points could be illustrated by things which didn't require very good reproduction. I mean points about

impressionists and [??]ists and people, these could be illustrated without having to have good quality good reproductions, wouldn't they?

**Bohm:**

How would you do it? It would be hard. You know, you've pretty well to be an artist nearly as good as they are to bring it out.

**Wilkins:**

I mean what is the difference between this thing about the points and — I mean one element of it simply is the one which is illustrated in any picture in a newspaper where things are made out of little points. If you look at it up closely you just see all of the points. I mean that's sort of one aspect of the whole thing isn't it?

**Bohm:**

Yes.

**Wilkins:**

I mean that can be easily illustrated —

**Bohm:**

That can be illustrated easily enough.

**Wilkins:**

You don't need an artist to show that.

**Bohm:**

No.

**Wilkins:**

And then when you see it was a totality of all the relationships and the form against [???], isn't it?

**Bohm:**

Yes. Well I think that could be done. I don't know how you would illustrate Cézanne's view of structure without reproducing something.

**Wilkins:**

As I said, I've never really sort of got to grips with that, so I don't know. I would've felt that for a book that it would highly desirable if you can get visual stuff into it.

**Bohm:**

I think you could get even a poor reproduction of one of Cézanne's [???], which would... I would show the structure.

**Wilkins:**

I would've thought, definitely in my case, I would've thought yes and without color.

**Bohm:**

Even without color. You could even put in some dotted lines to —

**Wilkins:**

It may be that Cézanne, did he always use color? I don't know.

**Bohm:**

I think he always did, but —

**Wilkins:**

There's probably some other people who didn't. Black and white or something. You see, if you've got some sort of concrete thing people can then sort

of grasp the whole sort of notion so much better. I mean obviously Biederman's got a point about words that the — When I saw some quote I think this morning, I think it was this awful education minister who had some quote about he was giving some poetry reading at some school, Bakehouse. Somewhere or another I saw something about words being — some American writer said something about words and how they were, and he got the idea very vaguely, but they were something like I'm probably quite wrong. It sort of scabs on the human body or something. That's not right. It was like saying something that here you have an underlying reality and these things are just kind of stuck on the surface in a rough kind of way. And yet people have the illusion that these things are really have some real sort of defined form or define the forms themselves, but they don't. Maybe it has nothing to do with Baker. But I mean this is quite true about words isn't it because how the words, I mean have each word has a sort of hundred different shades of meaning, which are changing almost month to month to some extent. And they're so dependent on our context.

## **Bohm:**

But I think the point Korzybski was the attention to how he used words, how you tend to identify the meaning in a fixed way. And how now you have to not do that to say that each use of the word is for that particular instant. Like saying this chair at this moment, and so on to the next moment and so on. Also making qualifications. Like saying allness, especially the use of allness is very dangerous because that tends to identify everything as belonging to one category when there's infinite variation possible. It interferes with free movement, doesn't it? You fix things in saying all people of this kind are this way, and so on. It's the basis of prejudice.

## **Wilkins:**

You see that thing about Bohr saying the use in which the word, and it's the more precise you try to make the meaning the less useful the word becomes. Incidentally, I likened something I showed to a philosopher here who was reading through something I read. He sort of crossed this out. It was obviously nonsense to him, whereas you can see?



## Interview Session - 9

**Wilkins:**

Unfolding and infolding, was either putting, speaking in terms, basically similar to what Hegel had said, or your making some of Hegel points in a new form, which made the fundamental nature clearer.

**Bohm:**

Yes.

**Wilkins:**

I don't know something like that.

**Bohm:**

Yes.

**Wilkins:**

I thought this was interesting. I think my general point is this. Maybe I said this on the telephone. It seems to me that if you come out with something in a publication using your particular mode of expression, that people will say, Yes, we read this,

we understand it somewhat and it seems good and we like this and we will take it seriously, or we were trying to think about it more. But it seems to me that if you have difficulty with any kind of new thinking, and one wants to use every possible encouragement to work on it. If you trace any connection between what you're saying and what other people have said, then people feel encouraged, they think," Oh yes, I have heard about Hegel. I never have understood Hegel. Or, Yes, somebody told me something or other yesterday. This chapter saying which connects with something else? Then they have more confidence and they say now I feel more secure in this whole situation, I am not being given something sort of totally out of the, you know, which I haven't heard, in any sense before. And I think that if you brought out some of these connections, which I think you are bringing out in the intellectual autobiography, it will encourage people a lot to pay more careful attention to your ideas and to work on them more harder and more thoroughly. You give them a bigger element of confidence. You see what I mean? Because I think that people are obviously always ready to give up aren't they? In doing any kind of new sort of thinking. They are always

relaxing into the same old mechanical comfortable ways of just chewing the cud. Am I right? I think that people need every possible encouragement to take new ideas seriously. And that is a specific example of that was that your infolding and unfolding puts its order that if you could relate to this to Hegel's thinking, or to anything else which they have some vague familiarity, even if they don't understand the other thing properly. But I think that it reassures them a little bit, you get my point? That they get along if they think that they are stepping out into some world of ideas which was totally new or something, that they get along and say, "Oh my god this couldn't be right."

**Bohm:**

Well, of course you can say that Saint Nicholas of Cusa talked about something like this with a implecatio, explecatio, and complicatio, and these three concepts he felt he had this notion of things being folded and unfolding. "Complicatio" means all folded together, and that is a complicated as just to say folded it all together.

**Wilkins:**

What works were?

**Bohm:**

Well, I can't remember the book but there is a...

**Wilkins:**

I think what I am getting at is if you read that stuff at some stage that you might put something in an extract in your book. I think this will, well, for two reasons. A) it fills in the picture on your intellectual autobiography how much I read this.

**Bohm:**

— well I didn't read that. I read it considerably later.

**Wilkins:**

Yes, okay, all right. But I mean I still feel that, alright I mean put it down like this, but things link up. But I thought the Hegel thing you were saying that you tussled with Hegel for a long time.

**Bohm:**

Yes, that's right.

**Wilkins:**

And out of this process?

**Bohm:**

Well, this helped, helped a little. What I think about Hegel is that it emphasized the notion of reality as movement as process, first of all, and also as process in which opposites were involved. For example, in my book, *Causality and Chance and Modern Physics*, was effected considerably by my talks with Mario Schoenberg in Brazil who had written a lot of Hegel. He was as Marxist. And my thought of causality and chance as too opposing movements to opposing which wove together in the whole, right. We have explained that same thing. And given any necessity, or really necessity and contingency more generally, any form of necessity is in the context of contingency; and any form of contingency is in the context of necessity. So they interweave in and unlimited structure and that was the content of my

book saying that, and in that since we understand causality and chance are appearing in physics.

**Wilkins:**

Was he a Marxist?

**Bohm:**

Yes, Schoenberg, yes. He was a Marxist. And no, he was trying to take Lenin's or whoever's advice of reading Hegel.

**Wilkins:**

Trying to what?

**Bohm:**

He was one of the few Marxists who took seriously Lenin's advice that they should read Hegel.

**Wilkins:**

I see, yes.

**Bohm:**

Hegel was an idealist and Marxists were prejudiced against him because they said, after all, he is an idealist and we are materialists.

**Wilkins:**

They say it was Lenin who gave him the advice?

**Bohm:**

But Lenin, never the less, said that in spite of that fact that he was an idealist, it would be good to study him.

**Wilkins:**

Do you mean that Lenin gave, was keener on people going to Hegel than Marx was?

**Bohm:**

Well, Marx turned Hegel upside down, and so Marx felt that he had made an advance on Hegel.

**Wilkins:**

Yes, so he didn't say he thought we should go back over the material?

**Bohm:**

No, he thought he had no reason to say it. But then Lenin said that there is a great deal in Hegel that is worth studying still.

**Wilkins:**

You mean whether you turn it upside down or not, the ideas are the same obviously.

**Bohm:**

Yes, so they said you might as well study these ideas because they are still very relevant. Now I think one of the few Marxists I know, anyway, whoever took it seriously was Mario Schoenberg. I was writing up my ideas of causality because I was trying to get some notion of what causality meant because I'd brought out this as causal interpretation of the quantum theory. I became interested philosophically. And then he brought out the idea that it would be one sided to just discuss causality. He said he ought to put the two together.

**Wilkins:**

Where did Schoenberg come from?



**Bohm:**

Well, he was born in Brazil, but I suppose he's got a Jewish European background.

**Wilkins:**

I see. I have not read any of these books on physics because I sort of rather naively thought; oh this is just on physics. You see so I am afraid I got I haven't looked at them but so.

**Bohm:**

I did start reading Hegel especially when I got to Israel I found some books on Hegel and it developed from there to see everything.

**Wilkins:**

Can you — which books were there??

**Bohm:**

Well, it was logic, there was a book Stace [?] that was a kind of introduction but it didn't go very deep. Then I found Hegel's logic from the encyclopedia and I read that at an enormous. And I meet this fellow, Mashulan Groll later who had studied Hegel

thoroughly and we had some talks about Hegel. Groll was also a Marxist who got very interested in Hegel.

**Wilkins:**

You felt he understood Hegel very well?

**Bohm:**

Yes. And one of the points that I think that was Hegel talked about the identity of our identity in difference is the one way of putting unity of opposites. To say that by making the opposites work on each other you'll come to a higher level of understanding. Do you suppose you take identity in difference well obviously they're considered to be different at first.

**Wilkins:**

But I suppose the opposites.

**Bohm:**

Opposites therefore they must be different. Now you could easily assert the difference of identity and difference. But it seems then that you are one sided because you have never not yet asserted the identity

of identity in difference. The oneness of the mind. But according to Hegel identity in difference have to be understood as both identical and different, right. The identity of identity in difference was a very subtle affair. Because what you have to say what is identity? Now, he doesn't just accept the category of identity, but he induces it from a long chain starting with being and not being, becoming going on into quality-quantity. And having gone through quality then quantity and then quantity giving rise again to quality at a new level, then you have a series of transformations. As quantity changes, there is another quality. But see, quantity changes the quality. So you have gone from one quality to another, on and on. Now that leads to the notion of essence, saying that in spite of all of this change something essential remains constant in that change. And the essence is the feature of identity.

**Wilkins:**

And the constancy is in the protest?

**Bohm:**

Yes. But it is also in the fact that all of the qualities are related as one substance. And therefore quality

— the identity is a category of first of all its identity with in all of that change. But then he develops the quality of identity further because if identity is essence it is the essence that is identical while the nonsense is not. All the changing things. Now, the difference is in all of these other things that are changing. Underlining them is supposed to be essence, the true being. Eternal and changing. But now the point is that in a way you could say essence shows, eventually develops to appearance, so you have the changing appearance of a changing show of things. Underlining it is supposed to be an unchanging essence, or identical. Now, it turns out that without the appearance, the essence would be and empty category. If there were no process of appearance, what would we say about essence? So the essence of the essence is the appearance. Therefore the appearance and the essence are essential; they are both part of the identity. In fact, identity is already seen to be — the essence of identity is difference of appearance. If it were not for this difference between essence and appearance, identity would have no meaning.

**Wilkins:**

Yes, I think I follow what you are saying, but I think I remember reading something, I think it was in Finley's book on Hegel, but funny enough, Finley was professor of philosophy in this college. That he seemed to be saying that being and not being are the same, you see, and I am afraid that I got stuck there.

**Bohm:**

Well, they are in one sense. What they are saying is that if you carry it out to the ultimate abstraction they are the same, because if you remove all qualities from being, you cannot distinguish it from non-being. Well, that's what Hegel said, though.

**Wilkins:**

I couldn't get the meaning and maybe I didn't read what it said.

**Bohm:**

But you see, one must think of the thought of being. Don't think of being because you don't know what being is, you see. Hegel is always discussing the nature of thought as a process. This was something

that I felt was very subtle and not appreciated in Hegel; he said pay attention to thought. Now it would ordinarily say pay attention to things. Now if you say pay attention to thought, how it goes, you are treating it as a process.

**Wilkins:**

Do you mean that you thought that other people hadn't properly understood what Hegel was, what was in Hegel's mind?

**Bohm:**

Not fully, you see that, it means that some may have. But I am trying to say that it's a crucial — it's getting close to what Krishnamurti was saying, you see, pay attention to thought; it is a process. Now the process goes through the unity of opposites. So we are not going to say being of things and non-being of things is the same because that would be absurd. But the concept of being the concept of pure non-being is the same. They are the same concept. Same thought.

**Wilkins:**

Well I said yes, but I?

**Bohm:**

Well, try to get to produce this thought of pure being. You see, if I say the being of this, that's not pure being. The being of that, the being of that. I remove, strip away, more and more characteristics, and finally I just say being. Now I say also you cannot distinguish those two thoughts. There is a mere distinction of intention but not of the thought itself. There is an intention to make them different, but they are not actually that different, until you add a quality to being.

**Wilkins:**

Yes, I think this needs to be spelt out in some length and got very clear. You are producing a book?

**Bohm:**

Yes

**Wilkins:**

Are the readers going to understand your book?

**Bohm:**

I am not sure how much of this I can put in?

**Wilkins:**

Do you think it is not possible to get it clear?

**Bohm:**

It can be made clear, but don't forget Hegel wrote a whole book on it and even then Bert you understand it?

**Wilkins:**

Yes, well I suppose Finley ought to have understood it.

**Bohm:**

Well, I have found that Stace didn't understand, another words, I think.

**Wilkins:**

I think I may have tried Stace.

**Bohm:**

No, several people I looked at.

**Wilkins:**

Wrote a book?



**Bohm:**

Yes that's right. I looked at several people's comments on Hegel and I could feel that they were rather superficial.

**Wilkins:**

Did you try Finley?

**Bohm:**

I think I looked at Finley, and again it was better but it was not really entire satisfactory. I think that these commentaries didn't really get some of the essential points. One of the essential points was Hegel was paying attention to thought as a real process.

**Wilkins:**

Okay, well now you have a very clear thought.

**Bohm:**

Yes. And secondly, he was discussing being he was not discussing the being of things. There is a physicist or scientist who tends to think of the being of something. But he was taking the thought of being. You could discuss the being of the thought of

being if you like. Now so we take this thought of being, which has a kind of being which you can pay attention to. See, what you can pay attention to is being. But how do you pay attention to thought? Because thought itself has some kind of being.

**Wilkins:**

Yes, right

**Bohm:**

But usually you pay no attention to that.

**Wilkins:**

The nature of [???].

**Bohm:**

You pay no attention, you only look at the content of thought. Which is the being of this or the being of that, right?

**Wilkins:**

Alright, well I think this is a very clear thought which I think that people could grasp very rapidly.

**Bohm:**

Yes. Now let me take the thought of being. I can say the being of this. Now, I abstract more and more qualities and I try to finally come to the most general thought of being I could get, which would — Any time I put a quality to being it's not fully general, because it could be otherwise. But suppose I say, I now remove all qualities from being; look at my mind there is nothing in it. Except the intention to distinguish it from nothing. Right? Or if I take the thought of nothing, it feels exactly the same as the thought of pure being.

**Wilkins:**

Yes, well look, okay, I see that the drift of your remarks but I think I would have to sort of sit down and quietly turn it over in my own mind. But I think that there is no difference here at all in your getting across to the reader this thing about considering the nature of thought. Because I think lots of people are aware of the fact that this is a problem. I mean Sarah for example, when she was work at medical school or something she had to project or something, and she chose to write an essay on the nature of thought.

Well obviously, she got into rather deep water as a writer.

**Bohm:**

It is difficult, that is a very difficult question.

**Wilkins:**

Quite. But she saw that it was something interesting. And I think that she was warned of it by all of her supervisors. I think that they were superficially thinking this was going to get into rather deep philosophical waters. But I think what I am getting at lots of people were seeing, okay you have got something there, and if this point is not being made clear, there is discussions of Hegel, then I think people immediately think, “Wow, this is something good. We must go along with this.”

**Bohm:**

Yes. The next point he makes is that if the two are identical, the difference between them has collapsed, so we have a contradiction because by asserting the being and non-being are different because the word “non” has been attached to non-being it must be different. Nevertheless, we have said as thoughts

they are identical. Therefore they are saying that — that contradiction is removed by the thought of becoming, and the thought of becoming we have being and not the thought of being the thought of nonbeing. But they are no longer independent self-subsistent thoughts, but they are sort of what do you call moments of the thought of becoming. You have the beginning and ending for example, beginning and ending cannot stand by themselves as thoughts.

**Wilkins:**

But what you have put in — I mean, you have introduced time in there. Haven't you? What I mean?

**Bohm:**

It isn't time, not yet, but it is movement, you see. We have beginning and ending as examples of the thought of becoming.

**Wilkins:**

Yes, alright we can introduce movement.

**Bohm:**

The beginning and ending made the thought together. It's when they are thought together you have got becoming. And becoming you do not distinguish, you do not say that being and non-being are separated, but they must be simultaneously present, the thought of being the thought of non-being.

**Wilkins:**

Are you saying that I can follow that business but can you go further and say all these entities of opposites have this element of movement in them?

**Bohm:**

Yes.

**Wilkins:**

That's a basic thing?

**Bohm:**

Becoming is the simplest case; it is harder to see in complex thoughts.

**Wilkins:**

Alright. Well, I think this business is very, very important.

**Bohm:**

Let me say that identity in difference have a movement. Identity moves into difference and difference into identity.

**Wilkins:**

Yes, well I think that it is very easy for people to take this being and not being and then say, “Okay we got becoming.” Now I don’t think that is at all difficult to people. But I think they might think, “Oh well, you know that they could just have thought this one up, this was clever, and how significant is it? But if that can be taken as a model for all these?”

**Bohm:**

Yes, let me explain how you can do it. You see suppose we now assert the following thought: The being of being and non-being is becoming. That becoming is, right? In other words, we no longer say being is, as Parmenides said, and non-being is not.

Right? And now we say becoming is what is. That is Heraclitian. Now if we say being is, then we are asserting the being of being and non-being? Because for becoming to be, it must be being and non-being together. But if we say becoming is what is, what is real, then there must be both being and non-being in it. So therefore, we have to say non-being is. You see, we are not applying the thought is to both being and non-being. Now it is important to say that we are not thinking about things yet, though this may reflect on things.

**Wilkins:**

You know thinking about thought?

**Bohm:**

Yes. So we say the being of being and non-being, but we could also say that the non-being of being on being that becoming also is a limited category. And finally, it collapses into another category, and now it comes into contradiction. And so it goes on developing in that way. Now so the appearance of contradiction is a sign that of movement. If we say that the reality is movement, but any time you abstract anything not moving, it will always be the



opposite. They will come into contradiction. Any attempt to assert a thought that it is not moving must lead to contradiction. So we say contradiction we can — but it is the function of thought to assert these static things. Right? Therefore a thought must come out into contradiction. That part of its process. But contradiction maybe taken as something which just makes it worthless, or in certain ways it becomes the step to the new thought.

**Wilkins:**

Yes, so you are saying thought, the nature of thought is to produce static things you say?

**Bohm:**

Yes, that's its purpose. The way we develop thought is we want to produce something fixed and it is useful. You see now it's...

**Wilkins:**

Sure, that you won't pick it up and therefore so on and so on.

**Bohm:**

Now you see now there are two kinds two modes of thought which you can use one is called Verstand in German, which has been falsely translated by the fellow who transcend the logic as understanding.

**Wilkins:**

Hegel's logic.

**Bohm:**

Yes. It's a bad translation which throws you way off, because the word "understand" means to comprehend as well. Hegel clearly uses the word comprehend in the other sense of what he calls reason, but the German word for reason is Vernunft, which comes from verb for vernehmen meaning to take hold of, and it means to perceive through the mind. You see the word perceive also means in Latin to take hold of. Paris of pere, to take hold of; and fernum to take hold of. Really it must of have been a translation. So now the idea is that Vernunft is called intuitive reason or a perceptive reason, whereas Verstand formal logic and static reason. Now it is necessary for the flowing reason to develop into,

crystallize into static reason. But then we make the mistake of saying that's the truth, and when once it is crystallized that's going to stand forever. So I say the word Verstand really means to stand, you want something that stands. Which we need. But it doesn't stand forever. And therefore it goes back to flowing reason. Now the contradiction is the way it stops standing; it collapses and starts to flow into something new. So we are thinking thought is a process, which when you try to make it stand eventually it must come into contradiction with itself because thought does not stand. Not merely the reality does not stand, thought is part reality, but thought itself cannot stand, it's a process.

**Wilkins:**

Yes, well I think I get the drift of this. But I do feel that if I think some of this needs to be sort of set down and one has to go over in one's mind. I mean I find it rather difficult especially after having sort of discussed various matters for some time, sort of difficult to follow. You know, I get sort of tired. But don't you think it's possible to get?

**Bohm:**

Well, if they try to do some of it, yes. I mean, do you think what I have said is clear enough?

**Wilkins:**

Well, I mean I think it has the seeds of character, I mean; this isn't quite putting it rightly. It seems to me that that type of thing you are saying ought to be clear.

**Bohm:**

Well, yes. Maybe if I said something more. People ordinarily just look at the continent and think that thought can just reflect its continent and just adjust to its continent.

**Wilkins:**

Yes, I think the more ways that one can say that kind of thing, expressing it differently, the easier it is to grasp it. Because I think you probably agree that I mean that most sort of comprehension of sort of new ideas comes from people — Well, they've got a partial, they sort of refer back to other bits of thoughts or understanding that had already, don't they, and they stop sort of somehow new stuff they kind of fit it in, and then finally you get a new

structure built up, and then they have sort of grasped the new ideas which to be important. Haven't they?

**Bohm:**

Yes

**Wilkins:**

I think that the whole grasping is a series of processes. And so I think that if you put it from certain different angles, then it is being dumped processes of grasping the whole. And it may be that one way you express it in words they have difficulty following, where another you express it is easier for them.

**Bohm:**

Yes, that is quite a difficult a

**Wilkins:**

I would have thought in principle and it ought to be quite possible to do this. I mean, after all, Bertram Russell said that he used one of the other, I forget what his term was, one of the greatest or biggest philosophers ever, although he didn't, he thought that he'd spotted some holes and his thought came

crashing down. Which seemed just like contradiction in terms.

**Bohm:**

Well, there are holes in some of his steps, and it doesn't mean that it's all comes down. I mean you see because some of his steps are not convincing. But I mean there are many parts, which are still very convincing.

**Wilkins:**

I would have thought myself that he was much more active or that Russell's thoughts would come crashing down on Hegel's.

**Bohm:**

I think the people to understand Hegel he would have to see that the whole thing is a flowing movement of thought itself that you are attending to. Now the people may say my thoughts can do anything; I just have to reflect reality. But the thought is a process within inherit dynamic of its own. It cannot help but come to contradiction when continued. I would have made the stand. And this is what Hegel is saying.

**Wilkins:**

Yes, well this is a special point about it having to come to contradiction. You see what I mean about this whole business of trying to communicate anything to a reader or and audience, you have to be trying all of the time to find out what sort of ground that they are standing on already, and then sort of work up from that being the long from that position. I mean it is sort of a general thing. And that I would have thought that it ought to be possible.

**Bohm:**

Yes I say that one of the important concepts Hegel had comes out in German that the contradiction is offkeyhobin [?], which means both kept and put aside. In the new level you put aside the old contradiction. But to put aside has a double meaning in German as in English that it may be put aside to just get out of the way or maybe put aside in order to be kept.

**Wilkins:**

To be referred back to?

## **Bohm:**

Yes, to have some significance you see. So it is still there. But it is not the same because now it is what is called a moment, a vanishing moment, and it's not there as a independent reality but as a vanishing moment or sort of a form lying on something else. But still it's there. So being a non-being are forms on becoming, you see. They are abstracted from becoming. Now you see then, I was just thinking, if you ask about becoming you get into a contradiction, see, if you have now said the coming is what you are going to stick with. But you said everything becomes, but this thought of becoming just remains what it is. You would have come to a contradiction because now, because we have said that thought we're applying these categories to thought itself and not just to things. And therefore, if you say becoming as a universal, and yet the thought of becoming does not become, that's a contradiction. So it collapses. And he comes to the saying that the thought of becoming becomes another thought, the thought of determinate being or it becomes itself. You see.



**Wilkins:**

I think some of that I would have thought should be very clear to the readers and people.

**Bohm:**

But see that is the difficult point to say that you are talking about thought and the principles must apply to very thought that you are using.

**Wilkins:**

Yes, okay, well I think that is a very clear point. It's a very kind of sort of concrete point.

**Bohm:**

I think that what I would try to do is say that these principles should be thought of — similar principles and should be thought of as applying in physics, saying that matter is basically a process and what is this becoming and so on. And I thought that this Hegelian approach could help in the analyzing their movements. Say for example, as necessity and contingency, causality and chance.

**Wilkins:**

Well, yes. So what you're saying is that your saying that thought in away is like matter? But it's just another?

**Bohm:**

It's in movement, but it's not the same movement as matter. But it's a movement capable of reflecting matter in general.

**Wilkins:**

And what, when you use the word consciousness you see this is what were I think sometimes I get in difficulty. Are you using consciousness and thought as being equivalent?

**Bohm:**

Well, it depends on how you use it, but certainly consciousness includes thought. This for Hegel includes attention. As with [???]. You see, I wanted to bring three words, consciousness, awareness, and attention. The word consciousness literally means knowingness, whether it means what people know together culturally and socially or individually. Now consciousness can be very abstract. It can be just know abstractly something or making and image of

it. You are conscious of it if you know it in that sense. You say I know various facts about Mars, and so on, and am conscious in that sense. But awareness is not the same as that. Awareness is based on the word weary. It means watchful, sensitive, and hateful. Therefore you're in some sense being sensitive to the process, you know, to the details to difference in similarity without fixed concepts with awareness.

**Wilkins:**

Well, that is a sort of state of being?

**Bohm:**

Yes, it's a state of being and but so is consciousness. But its consciousness has to do with knowledge organized as concepts.

**Wilkins:**

Yes, but if you take thought you then say thought everybody regards that as [???].

**Bohm:**

Well, thought is part of consciousness.

**Wilkins:**

Yes but they regard thought as being very clearly a process.

**Bohm:**

Yes, but they are not aware of it as a process. You see they are only aware of the content. People are not aware that of the flow thought as you are aware of the running of water.

**Wilkins:**

Well, they are aware of the fact that one thought leads on to another.

**Bohm:**

No, but that's merely abstractly; they don't actually see it happening while they are thinking.

**Wilkins:**

Yes, but at least they know.

**Bohm:**

They know about it. They are not aware of it; they know about it. That's the difference.

## **Wilkins:**

Yes, I see yes. I think this is a very important point. If we could be familiar with this knowing about it that you have this thought here and?

## **Bohm:**

They know about it, but they don't actually — If you are looking at a stream, you don't really, somebody can tell you I know about the fact that this part of this stream flows into another, but you may be aware of it, which is quite different. Now awareness requires attention. Now attention means literally stretching the mind towards something in Latin. But the attention I like to think of as a way of scanning the whole content of the brain to apprehend it into a whole. The eye will scan objects by jumping from one thing to another. Each person has a different pattern and it depends on what he knows, and so on. Now you might say there are all sorts of content in the brain, but this has to be brought together and attending to it. You may know all sorts of things that may actually work automatically. You know how to find your way home and you don't need to pay a lot of attention and so on. But attention means

stretching the mind to it, and so I had a dream I told you once where I had thought of a million fingers of light like laser pencils feeling out the brain. Sort of bringing it — And now what happens from there on we can't say. But let's say that there is an intelligence that apprehends the meaning of it. But then attention is a two-way process. It's like holding and object in your hand and learning about it. It is simultaneously changing it as you move and learn. So attention is changing the content of the brain as if it apprehends the content. And according to the perception of what it means. What we usually mean by consciousness includes all three. But you see, if there were no awareness and attention, consciousness would be a very limited affair. I mean, for example, you could read in a book about something and say that you know it, right? But you would not be aware of it and attentive to it. But then, according to Hegel, we can therefore be aware of thought and attentive to thought. Now generally people — we are not, we do not do that as a rule, you see, very rarely. We usually know about it. We know that thought has gone through a series of stages. But when we are thinking intently we really don't notice that.

**Wilkins:**

No.

**Bohm:**

We are noticing the content of thought; attention is going there.

**Wilkins:**

I think people have this illusion that there is some sort of, pro succession of thought is linked by some kind of very definitive object, don't they?

**Bohm:**

No, that's what Hegel is saying, that there are process which has this he may not (you know you can question whether he describes this correctly) but his proposal is that the process is this development of contradiction and offkeyhoben and such.

**Wilkins:**

Yes, you mean that is form of logic then?

**Bohm:**

If he calls it logic, he says that's the real logic of reason, flowing reason. Whereas there's a static, there is an abstraction that is frozen, erschtand, which has formal logic, as is logic. And people identify the logic of thought with that, but that is only a part of it.

**Wilkins:**

You mean this is a much more mechanical step?

**Bohm:**

That's right. Yes. It has its place, it's necessary to define, it is necessary for the flowing reason to define itself and make it stand for a while.

**Wilkins:**

I think this is what cause most people's lines of sort of dominated by, this sort of fact, that the whole mechanical logic does sort of occupy everything, and that's?



**Bohm:**

Let's put it that thought when it flows has a creative logic as it went. We could say that it's creative reason rather than mechanical reason.

**Wilkins:**

Yes, because you mean that in general one thought cannot be derived.

**Bohm:**

No.

**Wilkins:**

Yet it comes into being, and therefore there must be some essentially created element in it.

**Bohm:**

There may be. Anyway there is room for that, you see. To say that it may come out mechanically from the unconscious. But maybe there is a creative element. But just as we're saying that there is a sequence of these computer things?

**Wilkins:**

Yes, but if it came mechanically out of the cot [?].

**Bohm:**

It may be illogical as it comes out by the rules of former logic as it comes out of the unconscious? Now it may be illogical for creative reasons or for mechanical reasons. You know, people may be neurotic people will produce illogical thoughts because they are mechanically conditioned.

**Wilkins:**

Oh yes. Well I mean, not only the neurotic people. This is happening all of the time.

**Bohm:**

Yes, but what I am trying to say the mere fact that the rules of logic are not obeyed is not the proof of creativity.

**Wilkins:**

No, No. I agree. That's quite true.

**Bohm:**

Sometimes when the rules of logic are not obeyed this is a sign of higher order logic. Sometimes it's merely a sign that the mechanism is not working right.

**Wilkins:**

Yes, I suppose there is a bit of a problem that when you start to getting onto these different motions of creativity and everything, one wonders whether the thought might get a little out of hand.

**Bohm:**

Yes.

**Wilkins:**

I don't know. And this is always — well, it is like giving a lecture, that if you put too many things in the lecture that it would be hard to follow. I mean, one?

**Bohm:**

Yes that's what I was trying to say that I don't know how much of this they can get.

**Wilkins:**

Yes, I think in general, you see, you'll say a good lecture is one which has one main theme and so everything sort of builds up. Well, I say it's like a piece of music or something but it sort of holds together as coherence.

**Bohm:**

Yes, if you were to take say Mozart, was said to have produced a whole composition all at once and then it all unfolded you know by playing and all of the parts were properly ordered. You see, you could say that they have a kind of logic.

**Wilkins:**

Oh, you mean that you may be finding a new way of expressing what he meant by saying you saw the whole thing in his mind at once? I must say I find that a sort of a bit bewildering.

**Bohm:**

It sort of unfolded, but we say that the order of the thing is present in this unfolded form.

**Wilkins:**

You're referring to this statement of his that he would be playing around with various bits of music for weeks on end, then he would go for a walk in the country and suddenly the whole thing would appear in his mind.

**Bohm:**

Yes, and then he just has to unfold it time.

**Wilkins:**

Yes, therefore he had to go back and write it out.

**Bohm:**

Yes, write it out or play it.

**Wilkins:**

He said that it did not matter if there were other people in the room chatting with him or something, he could just write it out because it was already there. But he couldn't — he had to be alone walking in the country for this thing suddenly to appear.

## **Bohm:**

Yes, so there is an order there which is not the order of succession. It is the order of generation and creation. Somehow it produced all of that. Now, let's say that it unfolded in a certain logic of succession as well. But if you only look at the logic of succession you cannot appreciate the meaning of it. Now, that is the same about reason, we may think of reason as playing a series of notes. But then the meaning of it is sort of suddenly perceived and things even far back suddenly are relevant here and it all goes together into something new. So if you just stay where it is on that level, they will begin to contradict. If you can't jump to another level then you have a contradiction.

## **Wilkins:**

Yes, I think I saw this sort of thing going on when we went to Bolshoi and the Moscow thing, that you would have all of these people walking about on the stage and then sounds going and everything, and every now and again, somehow the magic worked. You have to sort of experience something happening. And presumably it somehow all added

up to something which was much bigger than the various dancers all hopping around on stage.

**Bohm:**

Yes, which is the generative order again. The choreographer the person who wrote the ballet or the music, they have got to think of all of the steps to put it on. The question is how did those steps appear? They appeared from some conception of the whole.

**Wilkins:**

Yes. I mean that otherwise this thing could be meaningless.

**Bohm:**

Yes. Now you see that the puzzle of the computer is that the steps seem to just be in there mechanically, but even in mechanical things there is implicit something more than mechanically. But it is only through the person who perceives it so far that it is there. Order is a question of context, and in certain

context certain orders would be called random. But in another context they are effective.



## Interview Session - 10

**Wilkins:**

You say that you had an idea about dialectic and then implicit order.

**Bohm:**

I was talking to someone about it yesterday. Brian Goodwin, you remember him?

**Wilkins:**

Brian Goodwin, oh yes.

**Bohm:**

See, we were making the point that the basic principle of dialectic is twofold. One, that everything is in process and including thought itself, and therefore, anytime you pick something you will get a contradiction. Anything fixed must inevitably lead to contradiction. That was the first point. And the second point is that thought always abstracts from the connections, and that also leads to contradiction.

**Wilkins:**

Just a minute. You're saying that if you fix things, you have a contradiction.

**Bohm:**

If your thought fixes things.

**Wilkins:**

But you're not saying that if you have a contradiction, it fixes things. I mean, it goes both ways.

**Bohm:**

Well you see, you can get a rather trivial contradiction by just making a mistake or getting confused or something. If your mind is not too fixed, you can drop that quite easily. If you hold to some principles that are very fixed, you can't drop it. Let's say I thought I was going north but I find out I'm going south, well, you just change. But say if you said, my identity is to go north, it's like saying I'm a Nicaraguan, therefore I'd rather be going north; then you couldn't change it. Therefore it would inevitably bring about contradiction to the fact. But Hegel

points out in the very internal nature of thought itself there's contradiction. Everybody can see that thought being unduly fixed will lead to contradiction with the fact, if it holds too fixedly against evidence. Some fixity is necessary. You do try to find a way around it and so, on but after awhile you see there is a contradiction. That's happening in physics in science all the time. We have certain fixed assumptions and we pursue them as far as we can. At first we assume that, well, maybe some further correction, something will save it and then finally we say, well, we've got a contradiction. It's like saying Michelson-Morley experiment contradicted the idea that you could measure your speed relative to the ether. It also contradicted therefore the implications of Newtonian conceptions.

### **Wilkins:**

So you're not saying that thought is always leading to contradictions and to unity of opposites and so on.

### **Bohm:**

That's one level that thought contradicts the fact. Everybody can see that's not what Hegel is talking about, but that is a common experience.

**Wilkins:**

But thought sort of goes in two ways. In one respect, one thought does lead to another in the way that people normally think of thought.

**Bohm:**

Yes. Now Hegel is saying more than that.

**Wilkins:**

But he's saying that that is so, but also there's this special feature of thought when you come to a contradiction.

**Bohm:**

He's saying that if you follow a thought logically, it will lead to a contradiction.

**Wilkins:**

Yes, but when you say, "follow logically," you mean that there is a whole sequence of thoughts following one another, one leading after the other.

**Bohm:**

Well, there may be a sequence. In the case of being an unbeing there is only one step.

**Wilkins:**

Yes. But in general, the point is that he's identifying two aspects of thought. One is the one where one thing leads on to another logically. And the other aspect is the one where you come to the contradiction.

**Bohm:**

But he's saying that you will inevitably come to a contradiction if you follow a logical chain because you have made fixed assumptions. You have this notion of verstand remember, something you understand.

**Wilkins:**

Yes. If it was a completely logical chain, it has a fixed assumption.

**Bohm:**

He says that since the very nature of thought is a process, it must come to contradict itself.

**Wilkins:**

I see.

**Bohm:**

Now, ipso facto if you make some assumption about some things, some facts, or some reality outside of thought, and you hold to it in a fixed way, since that too is a process, then you will also come to a contradiction.

**Wilkins:**

I think my only point is this: that some people might think, looking quickly at Hegel that what he was saying was all thought is nothing but coming to contradictions and nothing then resolving these unities of opposites. But he's not saying that. What he's saying is that this is only part of the total process. In between these things, there are these one thought leading to another without contradiction.

## Bohm:

Without visible contradiction, anyway. There might be implicit contradiction. So, he's saying that there are two kinds of thought, roughly. One he calls *verstand*, which falsely translated as "understanding", but it should be standing firm, or form of logic. The German word is not *understand* but *verstand* which is a translation of the Latin word for perception, *percipere*, meaning, to hold firmly, to grasp firmly. *Vernehmen* is exactly the same word in German. I'm sorry, *verstand* is a translation of "to stand firm", not to understand. It can be used roughly and loosely as "understand" but when they call it *verstand* it really means "form or logic". People using translations of Hegel often mistranslate that as "understanding" and it becomes very confusing. Then he also has "reason", which in English doesn't have the same meaning as in German. Also, "understanding" essentially means something very close to what Hegel means "reason". So you can see the kind of confusion that developed. His word for *verstand* was translated "understanding" which would be a better translation of "reason" than the German word for "reason" which is *vernunft*. The German word for "reason" is

vernehmen which is “to grasp firmly”, the same as “perceive” in Latin. And “comprehend”, again the same thing, to grasp altogether.

**Wilkins:**

Wait. Are you suggesting that British philosophers who have studied Hegel, that some of them may have fallen into this trap because they didn't understand the German?

**Bohm:**

Yes, that's part of it. And also they have missed the meaning of the concept to some extent. Had they understood the concept better then they would have understood the German.

**Wilkins:**

Yes.

**Bohm:**

Vernunft is roughly translated as “intuitive reason”, which means it isn't formal logic. It's sort of flowing. According to Hegel, this flows through contradiction. He says, thought must have a phase of standing firm. Well, you define things, and you go



through a form of logic, and sooner or later you'll come to a contradiction.

**Wilkins:**

That standing firm corresponds to a process of moving from one thought to the other.

**Bohm:**

With no visible contradiction. Although there maybe implicit contradiction.

**Wilkins:**

So that is really very misleading if somebody thinks in terms of “understanding”.

**Bohm:**

Yes. The word “understand” really means almost the same as the German word for “reason”, it means to grasp it intuitively whole, like a whole.  
Understanding is not the same as form or logic.

**Wilkins:**

It's more or less the opposite, really.

## **Bohm:**

Yes. So, they got it backward. The word “understand” should have been the translation of the German word for “reason”. And the word *verstand* should have been translated as “form or logic” or “a fixed thought”, or a thought with firmly defined assumptions. When you come to contradiction, then the movement of thought, the creative movement, is to rise, *aufgehoben*, to come to a new level, which both puts aside. The word “put aside” in German means both “to get rid of” and also “to hold”, “to keep” in some sense. The German word *aufgehoben* has that connotation. So we say the two contradictory thoughts are both dropped and yet kept in some sense within the new thought. But they no longer have a primary independent rule. And then you have a new thought which synthesizes, if you want to put it that way, and that’s a creative step. Now that connects to the implicit order in the sense we could say that new thought in some way was already implicit in the old thought. The contradiction in the first thought was implicit and then it became explicit, then the new thought was implicit in the tension between those two.

**Wilkins:**

Yes, that's what you mean by an unfolding. In a sense, it was there already.

**Bohm:**

Yes. And Hegel says in a sense it's all there already but it unfolds. That has been translated as "development". The better translation probably, the meaning would have been "unfold". I'm sure it was a good translation of the German word but I think the way Hegel uses the word "development" is roughly the way you would use the word "unfolding".

**Wilkins:**

Yes. I don't know quite what "development" means.

**Bohm:**

The root of that is unrolling, like evolution.

**Wilkins:**

Like development.

**Bohm:**

Same as evolution. “Val” is roll, you see. Revolve.

**Wilkins:**

Unrolling is the same as unfolding, isn't it?

**Bohm:**

No. It's not quite as dynamic. Unrolling you can think on a roll, it's unrolling like a plane. It's not quite as dynamic. Unfolding is a much more dynamic, a much thoroughgoing transformation.

**Wilkins:**

Yes, but in both cases you have the thing there already.

**Bohm:**

Yes, that's right. But it's there in a much more subtle way in “unfolding”.

**Wilkins:**

Yes, I can see unrolling, you mean, is rather a sort of simple and direct mechanical process.

**Bohm:**

And the word “evolution” has that root. But we could say that Hegel is saying that thought evolves through contradiction and resolution but it’s a process that evolves. But unfolds might be more accurate. But if you use both words you get across the sense, I think, of what is meant.

**Wilkins:**

Yes. You mean devolve, revolve.

**Bohm:**

Devolution is to go backward, you see.

**Wilkins:**

Just the thought of turning.

**Bohm:**

You imagine it’s rolled up on a printed thing, you see, that’s the picture. Whereas the other picture is a much more radical transformation from the innermost depths. But I wanted to say that this idea about the implicit order was in some implicit in

Hegel already. He did use the word “unfold” in several cases, but he didn’t heavily emphasize it.

**Wilkins:**

I suppose it illustrates the point that there is a sort of superiority in new ideas.

**Bohm:**

Remember, I mentioned Nicholas of Cusa with his Implicatio, Explicatio, and Complicatio.

**Wilkins:**

But how much did he talk about that?

**Bohm:**

He didn’t write a big thesis on it, but he had a chapter. He talked about it. That idea is sort of there in Hegel. A thought unfolding. The very word “implicit” as we use it with thought suggests the same thing. To say something is implicit in our thought means it is enfolded, becomes explicit, it’s unfolded. If we just take the root of the word, it suggests that’s the way thought goes.

**Wilkins:**

I was looking up the word “implicit” and there are slightly different meanings. Whether it means when you say it implies something, it means if you make a step forward you’ll then find something there. But that to some extent means that in a sense, he’s there already.

**Bohm:**

Well, that’s enfolded. That’s what it’s saying. Now, there’s some confusion, I think, because people use the word “implication” almost in the sense of logical entailment. But you see, a logical entailment is not exactly — that follows by a rule, whereas implicit usually has no rule, it’s just simply something is implicit and we haven’t stated it. So we may not even be conscious of it.

**Wilkins:**

Yes. Bringing the logic in is defining the thing much too narrowly.

**Bohm:**

Yes. But they unfortunately use the word “implication” as almost a logical consequence. It can be. We could say something has logically unfolded. You could then take the model that you unfold the meaning through a series of logical steps.

**Wilkins:**

I don’t think the ordinary dictionary meaning emphasizes the logical elements especially.

**Bohm:**

No, no. But anyway, so, you have this in Hegel.

**Wilkins:**

I still feel that if you didn’t want to put some of this stuff about Hegel down in this intellectual autobiography, I would have thought that if you can make clearer what Hegel was saying, that you ought to get it out into the open somewhere. And make it available because I think any clarification in this area is valuable. When you take a chap like Gorbachev, take that the whole situation over there, I mean, it’s not beyond the realms of possibility that if



Gorbachev remains influential that he would stimulate a new thinking in relation to all their dialectical materialism.

**Bohm:**

Well, if he would say that, he would be running on Hegel and take it seriously.

**Wilkins:**

Yes. If you read his speeches, I mean, he really, philosophically and psychologically, he seems to be extremely good and sort of lively. And there's none of this sort of dreadful old ritualistic stuff, which is churned out without any thought or any real feeling to it.

**Bohm:**

On the other hand, I don't know if Soviet Marxists would pick up things very readily.

**Wilkins:**

No, I don't think they would no more than the Soviet bureaucrats are going to pick up these ideas that forged democracy. In the Soviet Union, no, it would probably get colossal resistance. But that wouldn't

necessarily stop it happening because it seems to me that so much of Western thinking is really very seriously limited by people. You know, there's so much of Western philosophy is so much a matter of saying, you know, it's either got to go into this compartment or into that. It seems so limited and inflexible.

**Bohm:**

You see, I think Hegel made an opening and Marx made interesting additions, which were not fully digested. And Lenin made some interesting points; so did Engels. Beyond that, I don't think very much has been done. But I think that if you were to go back to Hegel you could criticize his idealism as too strong. I think we need a position which somehow brings out between idealism. You know, the extreme idealism of Hegel and the rather mechanical materialism that people have adopted even including the Soviet Marxists.

**Wilkins:**

I don't know whether the idealism-materialism question is so very important.

**Bohm:**

It may not be important, but Marx thought it was important and so did Engels and Lenin and all those that followed. And therefore, it's important for that reason anyway.

**Wilkins:**

I think Marx was a prisoner of his time in relation to the scientific development of the 19th century.

**Bohm:**

But that's two questions. One is whether Marx was right in thinking it important; you may question that. And two, but even if he was wrong, we must consider the fact that a lot of people have been affected by that and therefore we have to at least take it into account.

**Wilkins:**

Yes, I agree there. My feeling is I don't think I ever really found any Marxists who seemed to really, or at least couldn't communicate what these dialectical processes really meant.

**Bohm:**

Marx, in turning it upside down, felt that the contradiction was actually a concrete struggle in things and between people and groups and society. And Hegel regarded it as an opposition of ideas.

**Wilkins:**

But if the things in a way were corresponding to ideas then it didn't sort of —

**Bohm:**

Well, yes. In a way the things correspond to it. But the ideas were really the roots. The source of things were Hegel. When you grasp the idea, I don't know if we discussed that last time. When you grasp the essential notion of something then, in a way, you came in contact with it. You can put it picturesquely, that the thought of God is behind things. And if you grasp the thought of God then you have grasped the essence. You're in contact with the essence of the thing, right? And therefore, according to Hegel, by grasping the notion of something, you have really removed the division of subject and object. Now, that's a thing worth pursuing. See, most Marxists are

caught on a very mechanistic kind of materialism but they give lip service to dialectic. This idea of struggle can still be very mechanistic.

**Wilkins:**

I must say I've found what they've said to be extremely inadequate. I had sort of a go at that in the thing I wrote for your book.

**Bohm:**

I haven't got that.

**Wilkins:**

I tried to raise some questions more than anything else. You say subject and object, somehow —

**Bohm:**

Let me try to repeat Hegel's argument. Let's say we begin by saying the attitude of the practical reason is that the object is really essentially under the domination of the subject. As the purpose of practical reason is to bring the object under — to make it essentially an extension of the subject. He takes the extreme case of where you're hungry you eat something and assimilate it. But otherwise you

assimilate nature to your own needs, and therefore in a way you're ignoring the object in its own form, and you're managing to make it subservient to you. Which means that something in the object is really closely related to your thought, but you don't really understand how that happens. But in a way, practical reason is very subjective in its basic orientation. But the trouble is the aims which you use there are rather trivial. It's like people might say, well, God made cork trees so that people can bottle wine and so on. By making the universe dominated by such trivial considerations you really don't understand things. So, therefore he says the objective attitude, the attitude of science is, also metaphysics, is to take the object, let the object reveal itself, you see, to respect the object. You don't impose your own aims on the object which you do in practical reason. That makes, however, a distinction of subject and object right away. It's far more intense than in practical reason because the object is going to be assimilated to your need in practical reason. Now, is that clear so far? So then you say, I've got to understand this object, I just can't let it stand there separate from me, I've got to somehow bring it into me. So then you've thought about it, you understand the object as a special case

of the general or the universal. But now, you have still separated the subject and object because the universal is in you and this particular thing is out there and you don't understand how they are connected. So you have the contradiction of the universal and the particular. But then he says that's, let me see if I can recall this, that's resolved because if you go to the higher level, aufgehoben, if you come to the thought, not the particular thought of the object but the notion of the object, this includes both the universal and the particular. It's a universal which particularizes itself to create the individual. It's something which I call later the generative order. We've discussed that a little, haven't we. Now, see, that would be a way of understanding the essence of the object where there's no separation of the universal and the particular. But now, one attitude would be, well, I have that in my mind, but who knows what's going on out there? That would be the Kantian attitude. That's the thing in itself. I don't know that. The other attitude of Hegel is that there is an objective notion which does rule the generative process which you could picturesquely call the thought of God. And that when you grasped that notion, you have grasped its essence, you're not

separated from that thing at that deep level. By contacting the thought of God out of which that emerges, you are in contact with it at the deepest level.

**Wilkins:**

By contacting the thought of God —

**Bohm:**

He doesn't call it that, but I'm using that word picturesquely. Let's make a picturesque way of doing it just simply to illustrate.

**Wilkins:**

Do you mean by the thought of God the idea of God?

**Bohm:**

The idea of God which determines the notion of each kind of object. Let's say we have the notion of a certain species of living beings.

**Wilkins:**

So to speak, the idea which was in the mind of God.



**Bohm:**

Yes, which is carried out in matter.

**Wilkins:**

But then if the human being has his idea of God, well that also is equivalent too. He has the right idea, if he grasps the idea of God —

**Bohm:**

But Hegel is saying that is the same as to grasp the idea itself. He says God is the idea, the universal idea. But in so far as you do grasp it, then you are in contact with the essence of nature. Therefore, there's no separation of subject and object. That's his position. You can criticize it.

**Wilkins:**

It seems very reasonable because the whole nature of the way of thinking is to get rid of these rigid separations, isn't it? I mean, that particular rigid separation would necessarily go too. Then, you see, how does this link up with Bohr? Because I mean, Bohr is not thinking about dialectical processes, he's thinking about these complementarities.

**Bohm:**

But I don't think he is a Hegelian, you see.

**Wilkins:**

There do seem to be some degree of overlap, isn't there?

**Bohm:**

Well there is a little bit insofar as we have opposites there is that overlap. But I don't know whether the attitudes of the opposites is all that similar. Because he allows the opposites to be determined by the experimental conditions, now whether you had more of one or more of the other. Whereas with Hegel, it's an intrinsic, dynamic thought itself, a reality itself.

**Wilkins:**

Yes.

**Bohm:**

It's essential for Hegel to have the notion of the idea in and for itself, the universal idea. You see, he says the idea begins by being in itself. That is implicit. Then it becomes for itself. It gets to know itself,

explicit. But it's now divided against itself. Then it becomes in and for itself and then it's one again. It now understands itself.

**Wilkins:**

I don't follow clearly all those steps. But what is important is the net result of going through these operations where you get a feeling for the total process.

**Bohm:**

The total process unfolding. But you see, this is already suggesting the implicit order. You see, we begin with the idea in itself. He clearly says that it is the idea implicit. It doesn't know itself. It's just there implicitly. Then he says, the next thing is that objects are for it but then it gets to be for itself. In order to be for itself it has to be for itself as if it were not itself. That is, it produces a sort of an image or whatever you want to call it, in which it feeds itself. But that image is apparently another to itself. So, he's taking ultimately nature as that. But if you take the thought of God, nature is the other of the God but not really the other. God is for Himself in nature. Is that clear what I mean?

## Wilkins:

Well, more or less. I think in a way it probably doesn't matter because as I see it, one has a lot of sort of what might be termed neat sets of thoughts arranged one after another. The important thing is what they add up to, whether the thing makes sense overall. I suppose it's a little like physics and mathematics, isn't it? I mean the important thing is whether the— Isn't it a little bit similar to some of the physicists who saw solutions and then could only work out the mathematics afterwards. It was one that Piles was referring to, I don't know whether it was Eisenberg he said saw solutions first. But he seemed to be very well aware of the nature of this process and that the way of judging whether the mathematics was right was really by whether the answer sort of seemed to make sense. I think what I've got the drift of, at least, and presumably this is what would concern most readers of a book, is whether the general thing ends up sounding reasonable. And that going through these steps of thought can sort of reassure people on another level that the thing is reasonable. Presumably, if you took Hegel, he presumably had some general feeling about the

nature of things and sort of sat down and tried to write it all out in these sentences. Didn't he?

**Bohm:**

Yes. But also in writing it he sort of developed it.

**Wilkins:**

Yes. The thing is by writing it out, yes, you can develop it more and you can communicate it more. I can see that. It's so very important to write it down because otherwise floating all over the place.

**Bohm:**

Then you're making it explicit. I think that I want to make this distinction it sort of anticipates the implicit order. That there's a certain thought that's implicit that is all folded up like a bundle of wool, you don't quite know what it is. Now, you start to unfold it, making it explicit by means of words, images, and so on. Now, all these words and images seem to be something other than you. You seem to be looking at them. It's explicit. It's spread out apparently. It's apparently another reality but it isn't. Now, that's the relation of the implicit and explicit order. The explicit order is a show, that is the word

Hegel uses, a show of the implicit to show the relationship sort of spread out. So, the first step is the unfoldment of the implicit to spread out into the explicit to show itself.

**Wilkins:**

Yes. I see. What you're saying then is that if let's say someone like Eisenberg sort of senses the nature of the —

**Bohm:**

Like Mozart had it all rolled up in the beginning. That was an extreme case.

**Wilkins:**

As I understood it, the Mozart thing, he went around for weeks sort of picking up a little bit here and a little bit there.

**Bohm:**

But it all came together.

**Wilkins:**

Yes, presumably. I suppose you're right that having picked up a bit here and a bit there and a bit

somewhere else, then somehow or other he had a general feeling for some implicit thing built up in him and then. Okay. All these components, like a lot of insects buzzing around.

**Bohm:**

They suddenly form something.

**Wilkins:**

Yes. And that was implicit. And then, of course, having got the thing there he had some sort of feeling for the whole thing in his head and then he had to go write it out.

**Bohm:**

And you could compare that to anybody who has a flash of understanding or a flash of insight. It all clicks and then it takes some time to work it all out.

**Wilkins:**

But of course, the whole thing is based on the collection of a bit here and a bit there. That nothing like that could come into being without all those bits.

**Bohm:**

But it all comes together in the implicit order. That's what I'm trying to say. Not in the explicit order. It has to be then worked out in the explicit order.

**Wilkins:**

Yes. Somehow you suddenly realize somehow that all these bits of things around here, you have a feeling for the fact that it all goes together somehow.

**Bohm:**

Yes. Then you unfold it and spread it out to so as to see what it is. That's what Hegel was saying. Then there was the idea in-itself implicit that has formed. Then it became for-itself by spreading itself out and looking at it, what it really is. That's the second stage. Then Hegel has the third stage which is a much higher stage which is the idea in and for-itself where the unity of what it is in-itself and for-itself. Insofar as it becomes aware of what it is for-itself and connects with what it is in-itself, it reaches a very different stage of unity. We may come back to that later. I think this is also getting into beyond the division of subject and object and it's a very crucial



question, you see. People commonly go from the idea in-itself to the idea for-itself. That's not an uncommon experience. But the next stage is not so common.

**Wilkins:**

Give an example of that.

**Bohm:**

I can't because it's not very common.

**Wilkins:**

Sorry, the first thing.

**Bohm:**

That was just simply, you get this flash. It's all there at once, and then you work it out in time, and then spread it out in space, and so on. You draw diagrams, you write it out. You imagine it spread out in front of you. You're making it explicit, unfolding it. By looking at it, you see whether there's any value in the idea, and whether it may have been a false idea, or also what it means, how to go further, and so on. If you just keep it implicit, it's very limited what you can do with it. So that stage is

clearly very important but it leads to this division or even contradiction between the observer and the observed. The in-itself is looking at what is for-itself. See, if something is for-you it's sort of there for you. Therefore you see it. Now, if it's in-you, then you don't see it. But if what is in-you becomes for-you, then you see it within you. But then you get into this business that now it's no longer in-you, it seems to be just for-you as if it were something else. But it really isn't. It's you, still. The question then is to bring that together again in a higher stage which goes to for-itself and then it becomes in- and for-itself. The division of subject and object then disappears but at a higher level. The original unity was at a much lower level. We have a new unity in which you have brought it all together, both the implicit and the explicit.

**Wilkins:**

I think I've got part of it.

**Bohm:**

The reason I'm saying this now is it's one of the problems of the implicit order to get to that next stage which I haven't solved, you see. The implicit

order thus far is emphasized mostly, although not entirely, the in-itself. The enfolded become unfolded. As it were it becomes for-itself. Now, the question is how do we bring the two back together again, I think, is one of the crucial questions of making progress further. That's why I'm emphasizing this now just to anticipate something that might come later.

**Wilkins:**

How is that illustrated by considering physics?

**Bohm:**

Yes. I'd have to explain the implicit order. You'll see that there's a problem in the implicit order which has essentially the same kind of problem, you see. How the explicit order, the way we would put it is, how does the explicit order affect the implicit order? You see the problem. I said the implicit order unfolds to become the explicit order. But there must be a converse process which we haven't got hold of yet which is analogous to this thing that Hegel is talking about. But when we get the converse process, we won't just add another converse process, it will bring you to another level.

**Wilkins:**

You say you can't give an example of that because

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**Bohm:**

We haven't got it yet. The example is just simply, a concrete example like, let's say, take Mozart. He gets this vision of the thing. Or even if you take Beethoven, he gets some sort of vision of the thing and he starts working it out, you see. So that what he works out then affects what's in there and that goes back and forth. Beethoven would be a better example of what I have in mind. See, Beethoven was not just working things out mechanically. But he also had perceptions like Mozart, but he didn't get this whole thing right away. He sort of went through a series of stages.

**Wilkins:**

I see. Yes. A number of stages. I see.

**Bohm:**

Each stage was perceptive. And at each stage he got an insight which he had to unfold. He wrote it out

whatever, I don't know how he did it. Then from there that affected him and he did something else.

**Wilkins:**

But presumably you could say that Mozart went through the process of collecting up little bits and then they all went together. But having then got that written all that out then presumably he could see it all more clearly having written it out and that would have changed him.

**Bohm:**

Yes, except for the option that he never corrected it after he wrote it out, you see.

**Wilkins:**

No. Surely the mere process of writing it out must have changed him somewhat.

**Bohm:**

It changed him somewhat. Yes. It may have laid the foundation for some more work.

**Wilkins:**

The next thing.

**Bohm:**

The next thing, you see. Yes, that's true. Yes. But there clearly was a difference in the way Beethoven and Mozart did it but both ways are valid.

**Wilkins:**

I think this whole thing about things suddenly clicking together, I think what most people miss is the fact that they just don't come out of the air. They have been sort of collecting up for quite a while.

**Bohm:**

Yes. And to come back to this root "intelligence". That root, intellegere, "to gather from in between", right. The mind has been gathering from in between all sorts of things and then suddenly they jell and that's the act of intelligent perception. That's the act of creative intelligence.

**Wilkins:**

But really, the creativity is being active in the whole gathering process.

**Bohm:**

It's active in the whole process because there must be a certain creative attitude in the whole process which doesn't gather enough according to fixed rules.

**Wilkins:**

This is the sort of thing I've said about the DNA double helix. The idea that Jim Watson just sort of had a creative flashes with his base pairs or something is getting it quite wrong. I mean, he had a creative attitude toward collecting all the bits for some years.

**Bohm:**

Yes.

**Wilkins:**

This is what I think people don't realize. They seem to suddenly think he was sitting right there.

**Bohm:**

But hasn't he made it clear in his writings?

**Wilkins:**

Well, I think it is. I thought it was moderately clear from his writing. I think this was the point of my talk, really, which I gave in the college a year or two ago about the discovery was the creative insight which he had in the whole. It was a question, as you say, of general attitude which he'd picked up from his environment there and had this sort of attitude. So, he was constantly going around and finding a bit here and a bit there.

**Bohm:**

Yes. He was open to bits from almost anywhere. From in between all sorts of places.

**Wilkins:**

Yes. But he was using a creative selecting process and an attitude of what was worth collecting.

**Bohm:**

What you mean by creative selection isn't selection. You might call it intellect. You see, intellection. Because selection means to gather apart. See, when you select, you may mean according to a certain set of rules which aren't conscious. Most people



selecting would already have a set of rules as to what's relevant.

**Wilkins:**

Yes, but he had some rules.

**Bohm:**

No, but not fixed.

**Wilkins:**

Yes, he had both. Yes, you have to have some sort of element of flexibility in it.

**Bohm:**

You have to be able to gather from places that are quite unexpected.

**Wilkins:**

Otherwise, you're just like a computer. Actually, we had an interesting discussion on the social impact with the students the other night and they got really excited about religion and science. And one of them was saying, you know, if you have faith in science or religion, I forget somebody said, it's like Einstein going after his nose. And then one of the boys said,

(?)Ah yes. But you see, if you have faith and you're following your nose this necessarily implies uncertainty. Which of course, I thought at the moment, it was a very profound point but then you put it around and it's very obvious because you wouldn't need to follow your nose. You just go. But I mean, it is both a profound and an obvious point.

**Bohm:**

You have to explore not to just follow a fixed routine or a fixed path.

**Wilkins:**

Yes, but it's the ability to have this sort of general sort of sense of direction to go in. It is sort of like Combs? commitment and uncommitment and so on. It's a bit like that, isn't it? Flexibility doesn't mean that you wobble all over the place does it?

**Bohm:**

I think if you use the word openness, the new Russian word.

**Wilkins:**

Yes. Glasnost. But on the other hand, some people think that openness is just sitting there with your mouth open waiting for the flies to go in. It doesn't mean that, does it?

**Bohm:**

No. It means openness to new possibilities. It requires selecting from in between, and not holding too rigidly to the old way of making categories.

Now, that fits in with Hegel because you would say there could be nothing worse than opposites. Let's say you setup two opposites, and it seems you must choose one or the other. Hegel says no, you don't have to. You form a new concept which would be like as if it were somewhere in between. Both opposites are in it, but not in any independent way. So when it's characterized, it's somewhere between those two opposites but it goes tangentially into a new direction altogether. It's like saying between north and south doesn't mean somewhere on a line between them but it may be another direction entirely.

**Wilkins:**

Yes, quite. I think this is where one has to make very clear that in between doesn't mean in a sort of simple geometrical sense. Did you see the book on negotiation called Getting to Yes?

**Bohm:**

I haven't seen it.

**Wilkins:**

If you'd like to have a look at it, I can lend you a copy. It's up there. But a lot of this is on general problems of negotiation. And the line there seems to be essentially a Hegelian one that if you go into what appears to be so contradictory and mutually exclusive, then you can see the problem in a different sense in which both parties, negotiating parties, see if there can be a solution which both of them will gain something.

**Bohm:**

But it will be a different quality.

**Wilkins:**

Yes. It's a very sort of simple-minded little book but it's been much acclaimed. I think I've got some scribbling in it. But you might like to sort of just glance at it.

**Bohm:**

I'll take it home.

**Wilkins:**

Yes, that's good. That is sort of remarked on as sort of being a great advance in the study of negotiation. But really it is all sort of perfectly obvious from a Hegelian point of view.

**Bohm:**

Yes. I would also add that between maybe in the implicit order, you know, between those extremes. In other words, between doesn't mean just on a line between but it means some fundamental revolutionary change within. So that sort of has to be worked out then. Anyway, you can see now that this Hegelian line sort of foreshadows a lot of the implicit order at least implicitly. But again, the

whole notion is that the implicit becomes explicit so it's only natural that I want to make some of it more explicit. Of course, at the same time something else becomes implicit. You see, that's as you were saying about Mozart. Not that there's room for further development. That was one theme. I also gave you — I was looking at this view of cosmology which I had this notion of the whole understood as process in which every part would in some way reflect the whole. I remember when I was in Copenhagen, I think in 1959, I suddenly had this idea which probably other people have had of an infinity of a spherical mirrors reflecting each other. And, you see, in the image not only does each mirror appear in the other but the reflection, you know, the image of the image and so on. So that there's a kind of infinite reflection of each into all, right? So that was the picture of the universe I was sort of coming to, except that it was flowing. It was not a static image like the spheres but some sort of flowing movement in which that happened.

**Wilkins:**

Had Bohr died by then?

**Bohm:**

No, he was still alive. I probably did try to talk it over with Bohr. I remember I had some talks with Bohr. I can't remember their content.

**Wilkins:**

He died, I think, quite soon after, didn't he?

**Bohm:**

Probably a year or two after that, yes. But I tried to talk it over with him and he said, well the ideas were beautiful but they weren't really relevant. He felt more that the right approach was along the lines of complementarity. I mean, I can't remember anything more than that. But I think that he was a little hard to discuss with really.

**Wilkins:**

Well, I think that Pais make the point that Bohr is really better at talking than listening.

**Bohm:**

I told you about when we came to a crucial point and he'd start to light his pipe, you know, he would

clean out his pipe to try to sort of break the movement. Then he'd drop all his matches and he'd have to pick them up and by that time, of course, we'd forgotten exactly what the point was. It took him quite a while to do all that. I was developing this cosmology of the universal process in which everything would reflect into everything. I wanted to explain space and time itself, its order as arising in this process. That was a generalization of Einstein's idea in general relativity that measure or metric arises in the process of the field. It's not given, right? And I thought not merely measure but I was beginning to think that more fundamental notions like order, I was sort of getting a feeling, would arise out of the process. So, you could think this process was infinitely rich and even the ordinary ideas of order in between would arise out of it. The line between it and so on. So the simple line rather than a very rich notion. It's to simplify the idea of betweenness. The idea that there's a very rich notion of between which simplifies to that of geometry. Meanwhile in Bristol, I had been studying algebraic topology. I met a mathematician, went to some seminars, and he gave me a book by Hodge. I saw the similarity of the mathematics to quantum



mechanics. We've discussed that, I think, here before.

**Wilkins:**

Well, I can't say I remember.

**Bohm:**

But you see the idea was, first of all, you break up space. You begin with tessellation, a regular tessellation, and then you make it irregular. Then you make what I call the explosive transformation. You can imagine that each of the syntheses has a lot of little bits inside and they explode into the others, it transforms the space. That already anticipated the implicate order where you folded and unfolded. The notion that you could do all this in just discussing these integrals over syntheses which were a very natural way of doing Maxwell's Equations or equations like that or process equations. You could put it entirely into finite form, matrix form. So I thought that really was very interesting as quantum mechanics as a matrix form. So I said, "Look, it looks as if topology can be put into a form that looks like quantum mechanics." Then I thought of Einstein. We usually accept space and time as given

and we put matter into it. Then he said in terms of gravitation, he explained gravitation as a property of space and time instead of adding it to space and time. That was measured in curvature. Then I said topology goes deeper because topology has to do with relationships more fundamental to measure. Relationships are what is in the neighborhood of what is inside, what is outside, what is between. Such relationships are surely more fundamental to measure like distance or measure of time. So therefore I said, maybe quantum mechanics is the physical manifestation of the topology of space-time as gravity is of the metric. Is that clear what I'm driving at?

**Wilkins:**

I think so. I didn't quite get you but anyway.

**Bohm:**

Well, you see the first thing is to notice the contradiction between the quasi-Euclidean space-time and quantum mechanics. If you begin with Cartesian space-time, which is basically Euclidean, then it was modified by Einstein to curvilinear coordinates, but the idea was never very different. It

was continuous and well determined and so on. Now, that was an ideal medium for discussing classical physics, also Einstein's gravitational theory, and so on. The essential features of that mathematics was continuous, was causally determined, and it was entirely local. Mainly only local connections count. Is that clear? Either things are connected at points or by infinitesimal differences to have differential equations. Is that clear what the concept is?

**Wilkins:**

No, I'm afraid it isn't. In what sense is it local?

**Bohm:**

Well, if you write a differential equation you see that the value, the change which occurs from one point to the next, it depends on some rule applying to an infinitesimal distance. You cannot apply it to a finite distance. Therefore, the connection is called local because that distance eventually goes to zero. But we say the fundamental connections are essentially local. So we have continuity, determinism, and locality. Now, in quantum mechanics we have discontinuity, indeterminism, and non-locality. So it

seems the concepts of quantum mechanics directly contradict those of space-time. Either you say there are two approaches. Einstein's view was the space-time concepts are right and quantum mechanics must eventually be developed and modified into a new theory in such a way that it fits in. He followed that line. He didn't really succeed and I didn't really feel it was a promising line myself either. Most physicists don't. Now, the other line was to say that the quantum mechanics was the basic, new fact. Therefore, space-time must fit in with quantum mechanics. Just as Einstein had said before, if gravity — one must bring gravity and space-time together. So, the other way around, to say the properties of space-time must be the source of the quantum properties just as Einstein said the properties of space-time are the source of gravity. Rather than saying we have space-time and then we impose gravity. I say, we have space-time and we impose quantum mechanics, we get into a wild contradiction, you see. Nobody formed a very good picture.

**Wilkins:**

Yes, I think that's straightforward.

**Bohm:**

Yes. So my idea was that we would want to have a fundamentally quantum mechanical approach. Not only that, but a super quantum mechanical approaches in the sense that space-time would be the basis out of which we would abstract quantum mechanics as one of the properties of matter. Now, it seemed that this topology was a step in that direction because it was putting the laws of space-time, the connection of inside-outside, order, between, and various things, in the matrix form of quantum mechanics rather than the differential equation form of relativity and classical physics.

**Wilkins:**

I see. Space-time are beginning to take on some of the characteristics of quantum mechanics.

**Bohm:**

And one of the characteristics of quantum mechanics was called the unitary transformation in which any

region would then unfold into many regions. See, that was the basis for the property of interference. If a wave is going out and you use Huygen's Construction to say each wave is spread by little bits and therefore any one region can be transformed into the whole and the whole into any one region. But then, that property of Huygen's Construction was exactly the topological transformation the mathematicians were talking about in topology. So that encouraged me to think that quantum mechanics could be brought together with the more fundamental properties of space-time then those which Einstein had considered. I was thinking on that line. I also had that image of all the mirrors reflecting each other and so on which is tied up with this approach. The image of the flow of everything, the vortex. The particle has a kind of flowing pattern within the whole from which its interactions would follow because of the flow being pulled. So I had an idea of a kind of cosmology/metaphysics that I was developing which had all this in it. All that was in it so the general, qualitative form.

**Wilkins:**

Well, where did that lead?

## Bohm:

I was saying that I was thinking about it, you see. My first thing was to try to work out some of the properties, to understand this algebraic topology better. I saw that there were limitations. It nicely handled, Maxwell's Equation could be put into this form or Laplace's Equation and a number of equations. Dirac Equation could be put into it up to a point but not when you put interactions with magnetic fields, electromagnetic fields. And then Einstein's Equation, we didn't know how to put it in that form. That didn't seem to work. So, it seemed it was an interesting clue but some way limited. So it seemed somehow the topological and the measured properties we didn't know how to bring together. I was sort of working on that. There were all these contradictions in the attempt to do this. The whole idea was an attempt to resolve a fundamental contradiction so there was a Hegelian idea in there from the very beginning. I wasn't trying to resolve it just by mathematical calculation but by a physical concept that would resolve it. The general attitude of physicists has been that if you can find a calculus that fits the rules of relativity and quantum mechanics, then that'll be it. Now, they never found

one that did it exactly but they had, by means of renormalization, they were able to get a set of rules that would sort of look as if it would do it. Do you understand what I mean?

**Wilkins:**

You mean that they did join the two areas up, but you say not really very satisfactorily.

**Bohm:**

They produced a lot of calculated results but conceptually it was very unsatisfactory. You didn't know what the concepts meant and anyway, you start with one piece of mathematics and then you renormalize by subtracting infinite amounts of all sorts of things and you get what's really a different theory from the one you started with. It turned out, a lot of correct results were deduced from this new theory.

**Wilkins:**

So is this the present status of physics?

**Bohm:**

Yes.



**Wilkins:**

Quantum mechanics and relativity haven't been properly integrated.

**Bohm:**

Not conceptually. People are still working on it. I mean string theories and so on are an attempt to do that.

**Wilkins:**

I see. That is a very fundamental point.

**Bohm:**

I mean, they have hopes. The people working on string theory have hopes they're going to do it but again, we have to see. But even then, I say it's all pure mathematics. Now Greene, who works here at Kings(?) College, said that before you get principles, it may take twenty or thirty years. This was a new situation. In the past we used to start from principles and then go to the mathematics, now he says we're starting with the mathematics and we'll have to find the principles later. But I don't feel able to work that way. If they can do it —

**Wilkins:**

Which department is Greene in?

**Bohm:**

He's in the mathematics, you know, the physics. It's not the pure mathematics.

**Wilkins:**

Here?

**Bohm:**

At Kings, yes. The approach that I like is to try to get the principles physically, by reasoning, by thought, by the Hegelian manner or approach.

**Wilkins:**

Yes. So what you were doing then was an interesting idea but so far it hasn't actually borne any fruit so to speak.

**Bohm:**

Yes. It has developed in some way but it has not yet. Now, on the other hand, we could say that the string theory also hasn't borne any fruit. It has merely

partially solved some of the problems of the internal, theoretical problems. But it may twenty, thirty, forty years before it can bear fruit.

**Wilkins:**

So then you would say that this is about the central problem in physics then?

**Bohm:**

In theoretical physics, yes. This is the most interesting problem. The cosmological problem is the other but they're related. Then there are other problems which are not solved like the really right integration of thermodynamics with the fundamental laws and so on. But I think they're all three, these are the three basic problems and perhaps they should all come together. Now, I also made an argument at the time that relativity and quantum theory and special theory of relativity and the general theory of relativity and quantum theory. See, these are involved in this problem. Special relativity and quantum theory don't fit together very well. I've explained that. General relativity has some stillbirth problems that people are now working on hoping that super symmetries will help and that is that the

metric itself has to be quantized because it's dynamic. It becomes discontinuous and non-local and all those funny things. It becomes impossible to say what you mean by distance and near and far and continuity or discreteness. You see, conceptually it becomes a total mess. And you can say that the fluctuations, the quantum fluctuations of the gravitational field become the major factor when you get down to a distance of about  $10^{-33}$  centimeters. That's determined by its gravitational constant.

**Wilkins:**

Ten to the minus what?

**Bohm:**

Thirty-three. It's a long way down, but as a matter of principle, it's important. But it's a long way from any experiment. So you could say that probably the whole present physics breaks down there. You cannot define the gravitational potential, you cannot define length. It becomes dubious that you could define the velocity of light or a Lorentz Transformation. And you could then question, maybe, quantum mechanics also doesn't work. In mathematics, why should any of this stuff work?

Now the other extreme, which is very similar, is to go into a singularity of a black hole or the so-called beginning of the universe, where if you extrapolate to the singularity, you get a similar situation where nothing could be defined because all the fields are fluctuation too much. So it does look as if the theory itself has contradictions which indicate its limits.

Now the suggestion is that probably some very new theory may be needed but the fundamental new concepts may not be, may be the dominant concepts down around to  $10^{-33}$  centimeters and therefore they show up very weakly even a nuclear physics distances or cosmic rays. Therefore it's not easy to get hold of it. The idea was that some new concept behind space and time was needed which might not even continue the present quantum mechanics as well as gravitational theory and special relativity. You see, I didn't think one should regard special relativity as sacred as some people do because anyway general relativity already contradicts special relativity. It says that Lorentz Transformation only holds in regions where the curvature of space could be neglected. And also at very small distances, you can't define it either for the reasons I explained. So therefore, you could say that one should be open to

some view in saying special relativity, general relativity, and quantum mechanics might break down and possibly would tie up with thermodynamics because irreversible processes may be involved in all this too. So it seemed that we're approaching a situation where all these basic laws of physics are sort of hinting that something must change. That was the situation. I was sort of looking at all this.

**Wilkins:**

Roughly, what were the dates?

**Bohm:**

That was in 1959. I had this idea about all the spheres reflecting each other. It was about that time I was looking at algebraic topology. I continued in 1960, 1961, 1962, 1963, 1965. I was sort of gradually developing this. That was laying this foundation for the implicit order. I said, well okay, physicists don't seem to want to proceed by just physical intuition maybe they want more mathematics. I would like to weave together the physical intuition and the mathematics. It seemed that one would try to find some direct interpretation

of the mathematics of quantum theory in this way, in terms of space, the properties of space. Then I can remember (but I can't remember the date) I was watching a program on the BBC where they were talking about spin echo, but they gave it an example. This example of the droplet which was immersed in glycerin which spread out and then came back together again. It kind of pulled it into the glycerin and then unfolded. That sort of stuck in my mind that that would be very significant.

**Wilkins:**

You saw it on television.

**Bohm:**

Yes.

**Wilkins:**

It's interesting the amount of things one picks up watching television. I'm not quite sure whether this is the same what I saw in the article in Scientific American a month or two ago about stretching things very considerable how they sort of disappear. Anything there is as you go on stretching them, they reappear in certain stages in a faint, though

contrasted manner. I think it may be essentially the same sheer. But what you're getting in the cylinders, you're getting sheer, aren't you?

**Bohm:**

Yes.

**Wilkins:**

You're not simply getting stretching.

**Bohm:**

No, it's sheer and it's gradually sheering, splitting out. Now you see, it becomes a set of bands of ink. And then it looks as if there's nothing there and then when you turn it back, it would draw back to its original form. And then they continue, they go back in again.

**Wilkins:**

Yes. But I mean the sheer and the stretching is just a particular sort of geometrical transformation, isn't it, so the other of simple stretching might also work, mightn't it?



**Bohm:**

I suppose it could, yes.

**Wilkins:**

I'll look up that article. I just glanced at it in the library the other day. It had a photograph of a man's face and then on a computer, you stretch that photograph, and you stretched it more and gradually you got a lot of lines going across in the direction of stretching and the face disappeared. But the interesting thing was at certain precise degrees of stretching, the face came back. I don't whether the sheering model maybe this wouldn't happen at all, would it?

**Bohm:**

No, I don't think so. I think you would just have to turn it back to get it back.

**Wilkins:**

Yes.

## **Bohm:**

Well, that stuck in my mind as an important point because it was obviously tied up with all these topological transformations that I had been thinking about. The idea of exploding what was in each region of space and spreading it out into a large region. Then, what was the next step? Then sometime later, a time which I can't remember, I began to think about the hologram. Probably there were programs on the BBC again. And it struck me that the essential point about the hologram was not its three dimensionality but rather that each part of the hologram contained the image of the whole. Then I thought that it was rather similar to, you get interference bands which are rather similar to the bands you had with the sheering of the ink drop. They're not the same but something similar. The idea then, those interference bands implicitly contain the image, three dimensionally. And similarly, all those bands implicitly contain the ink drop. So I said, in both cases you have enfoldment. But now the point about the hologram as Green's function that determines the interference. It's the organ's construction that determines the interference. But that construction is fundamental to all wave

equations and to all quantum mechanics. You see, the whole Feynmann diagram and all that is just a systematic way of doing that construction. And therefore the entire log of quantum mechanics were in that image, you see.

**Wilkins:**

In which image?

**Bohm:**

Of the hologram. Because we say that enfolding and unfolding were the basic movement of quantum mechanics.

**Wilkins:**

So the mathematics of the two things were equivalent.

**Bohm:**

Similar, anyway. And that connected up with some real similarities of that topological structure.

**Wilkins:**

I see. So this similarity is on a more sophisticated level than the one which you write in your book

pointing out general features of similarity expressed in words.

**Bohm:**

Which one?

**Wilkins:**

Well in your wholeness in implicit order.

**Bohm:**

What about it?

**Wilkins:**

What?

**Bohm:**

What are you saying?

**Wilkins:**

When you're comparing what's happening in quantum mechanics with the hologram, I mean, well maybe you have got it in another chapter in the book. I don't know. Anyway, I get your point. I'd

simply ask you a question. In that book, do you in point deal with this mathematical equivalence?

**Bohm:**

Well, no. Not in detail. I do some. I show the equivalence of the quantum mechanical algebra. The similarity to it anyway.

**Wilkins:**

To the hologram?

**Bohm:**

Yes.

**Wilkins:**

I see.

**Bohm:**

I wanted to bring it all together, and that suggested a different view of the whole of reality. Turn it upside down, you see. Instead of saying that the explicit order is fundamental, I would say that the enfolded order was fundamental and the explicit unfolds. I turned it upside down. See, everybody knows about unfoldment and so on. That's part of our culture. But

we say really what's happening is there's a bunch of particles and this unfoldment is only a way of talking about the particles are moving. In the case of the ink drop in fact there was a particle model underlying it, therefore it was only an analogy. In the case of the hologram there isn't. And especially if you consider the quantized nature of the field of the hologram rather than its classical nature. I didn't do that in my book but it gets far more difficult. But then you really find out that you can't make a mechanical model at all. So I said let's turn it upside down and say there's a fundamental. The basic order is the enfolded order. And the unfolded order emerges from it. Rather as we were saying in the idea in the mind. So that suggested also a parallel between mind and matter, they operate in the same order which helps to solve this problem which Descartes produced by saying mind and matter were distinct and unrelated. There was no way to relate them, they were so different. Descartes had said matter is extended substance and mind is not. It's thinking substance and he said, how could they be related, they're so different. He said God related them because He's beyond both. But when you drop God, you don't know how to relate them. But if I say

mind and matter are basically similar, they're in the same order, therefore it's not an insuperable question to think of how they might be related.

**Wilkins:**

Well, this is set out in the later chapters in that book.

**Bohm:**

Yes, but I should include some of that here.

**Wilkins:**

Yes, quite. I think actually in relation to that book when I was going through one of the chapters again, I was getting just a little bit unclear on some points. Maybe it would be sensible if I brought the book in.

**Bohm:**

Yes.

**Wilkins:**

I think maybe the difficulty is that these various systems which you're referring to, concrete things like the hologram and the ink drop. You point out in various stages that these are sort of only analogies and there are limits to the analogies. There maybe

that there's certain things that appear to be contradictions and what you say are simply a consequence of the limitation to the analogies.

**Bohm:**

The best analogy you've got to the implicit order is your own experience with your thought process.

**Wilkins:**

Sorry. In what respect?

**Bohm:**

Because it unfolds into an image which is explicit or into a process.

**Wilkins:**

I see. Can you say that again?

**Bohm:**

You see, like I was explaining with Hegel, the idea is first implicit only in itself and then it unfolds, it spreads out, in the imagination or in some other form like writing or painting. It becomes explicit, unfolded. You could say the painter's idea is implicit but made explicit, unfolded on the painting.



**Wilkins:**

It's like Einstein with his sort of feeling. So you're saying, what was the first point?

**Bohm:**

I'm saying that the best way of appreciating by what I mean by the implicit order is to consider this process.

**Wilkins:**

Ah, yes. You mean of what you have, say, an intuition of which you then, the whole process of making this explicit.

**Bohm:**

Now I'm saying nature works in a similar way and therefore the particles of nature, the separate things, are not the ground but the ground is the implicit order out of which these forms emerge and constantly go back and emerge. They grow. It's the constant repetition of the form or the constant recurrence of the form which we recognize and we only see that little bit and we don't see the whole

from which it comes. I call that the holomovement remember.

**Wilkins:**

Because I suppose the reason that most people won't see this point is that without having turned it over quite a lot they won't be aware of the fact that these explicit thoughts that they have, have somehow derived from something implicit, will they?

**Bohm:**

No.

**Wilkins:**

The average person doesn't seem to be aware of this or only very vaguely so. But I think it seems to me to be a perfectly clear idea.

**Bohm:**

You could then take Mozart, you know, take the painter.

**Wilkins:**

There's no reason why people shouldn't be able to follow that. But it does need explanation.

## **Bohm:**

Yes. That suggests that nature is infinitely subtle. It's not really. Subtle means intangible basically. But the tangible and the manifest are the product of the intangible and the unmanifest. That turns a mechanistic point of view upside down because they say the tangible and the manifest are fundamental. And the intangible and unmanifest are abstractions of our mind. Now I'm proposing that the intangible and the unmanifest are the reality and the tangible and the manifest are the recurrent, relatively independent features that unfold. Just as they are in the mind. You see, the explicit thoughts that appear in your mind arise from intangible, non-manifest background.

## **Wilkins:**

Yes. So the underlying processes in the mind are these sort of vague, well I don't know. It's a whole complex of all sorts of things going on, isn't it? It's coming in through perception and then contributing to general attitudes which then give rise to sort of rather undefined notions which then, you mean, go on to become more explicit.

**Bohm:**

Yes.

**Wilkins:**

So what you're saying is the basic nature of thought is this alternation which is implicit to explicit.

**Bohm:**

And back again.

**Wilkins:**

And back again. Whereas the question of feelings and thoughts is somewhat secondary.

**Bohm:**

Well that's part of that. You see, feeling may unfold into thought and thought into feeling. According to a certain vague feeling, it may unfold into a well-defined thought. But then, that well-defined thought may give rise to a further feeling.

**Wilkins:**

I always thought needs a feeling to keep it moving, doesn't it?

**Bohm:**

Yes, but the thought also contributes to the feeling.

**Wilkins:**

Yes. But then how does that sort of relationship between those two things, which as you say are sort of part of an ongoing process, how does that relate to the whole? Of course, they always said there was intuition and perception, no, sensation which was another complementarity he referred to. Would that correspond to the particulars going in through sensation?

**Bohm:**

That's getting a little too — We want to look at thought alone, you see that, you see, thought can affect feeling and out of feeling will unfold into thought. Now like Einstein's vague feelings unfolded into thoughts but that in turn went back into the feeling.

**Wilkins:**

Yes. There's probably no particular point in trying to dissect the? Well, I mean you are in a way if you're

talking about the explicit and the implicit. You're doing a sort of a kind of a deception there, aren't you?

**Bohm:**

Well, it's a distinction not a dissection. We're not saying they're separate. That's the point.

**Wilkins:**

Yes. But I mean the thinking and feeling is another.

**Bohm:**

Well it's a distinction.

**Wilkins:**

Oh! distinguishing. Anyway, there's no need to make any heavy weather about the fact that there are these different ways of distinguishing the fundamental nature of thought. That's your point.

**Bohm:**

Yes.

**Wilkins:**

There might be other ways of distinguishing elements in thought. At least that's two.

**Bohm:**

Yes. You distinguish say form and content. There are all sorts of distinctions like that. The whole dialectic of Hegel is based on studying those distinctions and they how develop.

**Wilkins:**

I might try to see what you meant by sensation and intuition because I have never quite grasped that and it maybe that that's another thing makes one get that part of it clearer that way. Because intuition is certainly sort of general whereas sensations are, well, they're not always particular, are they?

**Bohm:**

I don't have much feeling for that.

**Wilkins:**

Certainly, intuition's sort of a general, vague, sort of feelings about a total situation. Whereas, I mean,

that seems to be what that means. Whereas sensation — Well, maybe he's meaning to use the word sensation as being sort of particular in things and in that sense it would be the same thing. The one being general and the other particular.

**Bohm:**

Yes. And the whole point of Hegel is to see the oneness of the general and the particular by rising to another level. Now that's something which we have to go into. That's later because that maybe a clue to what has to be done with the implicit order in nature.

**Wilkins:**

You mean sort of carry it on to the next stage. I'll look up this thing on Jung because it would be interesting. It's the other pair which I've never been able to sort of grasp. Did do that because well your point is there are a whole lot of these distinctions, pairs that you can distinguish. But it would be interesting to see if that one does come the same way because as I may have said, the only place I could find Jung's thought laid out clearly was in his Tavistock lectures where he was talking to a whole lot of psychoanalysts. And he really began to explain



what in the hell he was bloody well talking about in front of these people. He wrote most of his books. He used, throwing all these words around and never making clear what he really meant by them. I could look that up.

**Bohm:**

Yes. That might make the discussion next time. Anyway, I think that's the best. And also, see with the quantum mechanics is the example of the implicit order. You see, the point is you will only find analogies within the ordinary spheres like classical mechanics. It's the basic. The laws are really not, the fundamental laws are really taken there to be the explicit laws. So, physics starting around the time of Newton and Descartes and before began to emphasize these explicit laws and began to think that was all there is. By reducing everything to that, they got into mechanism. Now, the implicit order is created in the sense that the ground of this holomovement that was undefinable, the total movement, which includes mind and matter. Therefore the possibility of their relationship.

**Wilkins:**

Yes. So that none of these things can be finally tied up. It does seem the peculiar characteristic of the human mind, every century or so, starts to shout about how they've got everything tied up, haven't they?

**Bohm:**

Yes. Well I think that's part of the search for in the sense that they wanted to avoid the sense of uncertainty and insecurity —

## Interview Session - 11

**Bohm:**

It's hard to remember, but we were discussing dialect last time in relation to the implicate order. I think that I should say, and this was a period around 1963, 1964, 1965. The sort of things that were happening to me were as follows. I had sort of gotten somewhat disenchanted with science as a solution to human problems, over the period of years, and culminating in Bristol and coming to London. I had sort of turned toward Krishnamurti who had another approach. If you go back to my earliest years, I felt that there would be progress, and science would be a key part of it, would get rid of poverty, and things would get better and better.

**Wilkins:**

A 19th century view.

**Bohm:**

Yes, which really held into the early 20th century. And then after the second World War, it became more and more clear that it wasn't happening, and the dream of socialism wasn't working. The 20th

Congress made that clear. So neither science nor politics, nor the combination of them, appeared to be the answer. As I said, I had began to read other things like Gurdjieff and Ouspensky. The question eventually came to me and Krishnamurti where we went into the nature of thought. Krishnamurti had two points to make which made a deep impression on me. One was that thought, which we take to be our highest achievement, is causing the trouble.

**Wilkins:**

Yes. Did you find that notion rather shocking at first?

**Bohm:**

Well, I found it fascinating.

**Wilkins:**

So obviously, you didn't find it entirely repulsive.

**Bohm:**

Well, I had sort of been prepared for it by Gurdjieff and Ouspensky, and also by the general feeling of being let down by science and politics, which is the whole rational approach.

## **Wilkins:**

Incidentally, if I can just interject, did you see that some of the big American firms are now taking up Gurdjieff type trading for all their people, so they get a close sense of community with all the workers in the organization by doing special crash courses and so on, a Gurdjieff sort of psychological brainwashing, but I think this is what it amounts to. It's very interesting the way these weirdo things are getting taking up by the capitalist establishments.

## **Bohm:**

There is a certain amount of value in them. The only point is that when they're pushed into the wrong context, they become absurd. Gurdjieff himself was not a balanced person. So I felt that Krishnamurti was a different sort of person than Gurdjieff, because I never felt attracted to try to find Gurdjieff groups or Ouspensky groups, although I could have found them quite easily. Krishnamurti was different. Especially in the early days, I felt we really were able to talk freely and he had a very lively mind, and open, and he went very deep. So the first point he made was thought, and the second point was that

there's something beyond thought, which is whatever you want to call it. Some people have called it the Sacred, or the Holy, in the ancient religions. You could say the Infinite. I used to call it the Infinite. In fact, even when I was in Princeton, I was fascinated by the idea of the infinite. Also in Brazil, I wrote the Causality and Chance in Modern Physics. I developed the idea that infinity of nature.

**Wilkins:**

It isn't Hegel in a way, if you're taking thought as being the ordinary Aristotelian intellectual thought — I mean, Hegel is making the point that there's got to be something beyond that.

**Bohm:**

Yes. He still calls it thought, but it's thought which differs in two ways. One is that it's moving; it's no longer a fixed category. And it's also all interconnected.

**Wilkins:**

This holistic energy.

**Bohm:**

Holistic. The second point is that it is thought to which attention is paid. This was the key point that Krishnamurti was always emphasizing, the need for attention, and attention to thought especially. We included in thought feeling, desire, and will, the whole structure of consciousness. Because thought is the past participle of to think. It is what has been thought. And in that, there is always a mixture of feeling, desire, will. Whenever you think, whenever you remember something, there is a mixture of all the effects which went along with that experience. Whenever you think there is a mixture of all those, including your motivation, and so on. So I had that point then that?

**Wilkins:**

I think my point was in a way, Hegel is making the same point, but I think he probably didn't recognize it sufficiently because he was so dominated by this 18th century Enlightenment.

**Bohm:**

Right. Yes. I think that is making a similar point. It's not exactly the same as Krishnamurti because Hegel wanted to say that at least dialectical thought would be necessary, but Krishnamurti was tending to rather devalue all thought. He sort of accepted it as useful technically. And then sometimes he said there's another kind of thinking which is different, which you might guess what Hegel was talking about.

**Wilkins:**

Yes. But that was just a pure guess.

**Bohm:**

Yes. But you see, Krishnamurti was never very clear on what he said about it. So I think that one of the weaknesses of Krishnamurti was that he tended to go too far in his statements and he put them in such a ways as to overdo it, in this case, to devalue all thought. Later on, he would say perhaps there is another kind of thought, but that came in too late to affect the emotional impact.



**Wilkins:**

Yes. It was a little bit like his condemnation of groups and other things. He tended to be a bit sort of dogmatic.

**Bohm:**

Yes. But then he'd say that of course, sometimes you must have a group, but that would come too late. He would already have conveyed it.

**Wilkins:**

Yes. And already set up all his followers going around saying, "No groups. No groups."

**Bohm:**

Or, "No interpretation." He used to say, "No interpretation," and then it was absurd, because everybody must see what Krishnamurti means. Obviously he meant nobody who interprets should interpret as an authority representing Krishnamurti. But he didn't say that. He said, "No interpretation," and people became afraid to talk about anything he said. They said, "It's such a mysterious thing. You mustn't talk about it."

**Wilkins:**

I see. It was like the people who said that you shouldn't be making an effort and that you shouldn't work for your examination.

**Bohm:**

Yes. He uses language in a rather exaggerated way at times, giving it a special meaning, and then he corrects it maybe the next day or the next year.

**Wilkins:**

He could have used the dialectical thing there to say that. He wanted no interpretation, and he did want interpretation.

**Bohm:**

Yes. No. But I meant though, different kinds of interpretation. That's the problem. There's the interpreter who comes in as if he's just simply translating Krishnamurti for the common people. But anybody who talks must give what it means to him. To interpret is to say what it means. So then later on, he said, "Well, of course you must say what

it means to you, but make it clear that it's your view and not Krishnamurtis."

**Wilkins:**

I think my only point is that distinction of different sorts of interpretation might be put in an alien manner. I think [inaudible].

**Bohm:**

Yes. Well, you could. To say there would be the extreme in which, to a certain extent when you interpret you are attributing this to Krishnamurti, but you have to make it clear it is you who is doing it, and that mistake is often made when people quote other people, and so on. In any case, he didn't make it too clear what he meant. Let's put it that way.

**Wilkins:**

I accept that he found that at times.

**Bohm:**

And that invited interpretation since he didn't make it clear what it meant, then other people said what it means, and I'll try to make it clear what it means. But then that might look like an exercise of authority

to him, saying, “Hmm. They’re trying to use their position of authority.” There were people that used to set up groups and would be minor gurus and so on.

**Wilkins:**

Of course, he did tend to be authoritarian himself, too, although he was in a sense trying not to be. He was inevitably caught in a trap.

**Bohm:**

Well, you see the word authority means author. I think, again, that he would finally have to say that that kind of authority is inevitable, but the other kind where a person who is not an author claims authorship, that’s really what he’s saying. That you, who are not the author of this, are claiming to be the offer, and that you have an authority for what Krishnamurti says. So let’s say that if you do say something, you must accept authorship, and say, “This is what I say, being inspired by what Krishnamurti said.”

**Wilkins:**

But this is using force in a way, isn’t it?

**Bohm:**

What?

**Wilkins:**

To take an authoritarian position is using force.

**Bohm:**

Well, authoritarian is a wrong use of authority. You see, suppose a medical man is an authority on his subject, and he can talk with authority about it. But if someone who doesn't know anything about it talks with the same authority, he is using authority falsely.

**Wilkins:**

Yes. But I think the whole question is how does the authority communicate their knowledge to the other people?

**Bohm:**

Well, he says it with a great deal of energy and certainty. You see, he shouldn't impose it, but at the same time, if he's confident about what he says, then his confidence comes through, right?

**Wilkins:**

Yes. But I think the whole thing is that I suppose he did every now and again say that you should just accept things because I said them. But I think it's difficult to set up this sort of?

**Bohm:**

Yes. Well he didn't really invite deep questioning and criticism. He could be very unpleasant and dismissive.

**Wilkins:**

Yes. Of course, I only knew him later on when it was probably not so easy for him.

**Bohm:**

Anyway, that was where I was going. So Krishnamurti, going into it again, gave me a great deal of energy, not only for that, but also to do things in science. In other words, I felt that in science, as it was, I was losing my energy, which I couldn't quite see what to do because there was all of this formalism everybody was getting into, and they didn't want to have ideas.

**Wilkins:**

So it gave you the encouragement to develop new approaches in science?

**Bohm:**

Yes. And it liberated a great deal of energy in many ways. At that time, I was sort of learning what he meant and it seemed very creative. I would talk about it to anybody who wanted to. Now, there's a way to go to Zaanen [?] in 1963. From 1963 on we went to Switzerland every summer and talked with him there, and so on. It seemed for a couple of years a very creative thing. Now this question of wholeness, and it drew my attention specifically to fragmentation. I had known about it, but I felt very clear that fragmentation was a key problem. It turned my attention towards wholeness.

**Wilkins:**

But you already got that to some extent from Hegel.

**Bohm:**

Yes. Well, even before that, I had always been interested that way. But it sort of gave an extra energy in that direction.

**Wilkins:**

It's really the wholeness thing goes right back to your teen age.

**Bohm:**

Yes. So then, if you'll recall, there were the seeds of the implicate order there, and my work on its apology, on these mosaics, and also the seeds of the implicate order were in the dialectic, in the sense that things unfolded, what was implicit unfolded and became manifest. Then I remember I saw these examples of the ink droplet and the hologram. I was sort of thinking, how will we understand the quantum mechanics. That had always been my question ever since I saw it. The quantum mechanics seems to have a tremendous truth in it, but it's very mysterious what it means. I had developed this causal interpretation in 1950, with a particle. In addition, at that time, I developed another one which



was foreshadowing the implicate order, which was if you send an electron wave end against an atom, then a scattered wave appears, going outside of the original beam. You detect a particle in the scattered wave. The question is, although the wave scatters, you detect the particle, and the question is how does that happen? That's one of the mysterious features of quantum mechanics. So I suggested that there be a second wave coming in, focusing in on the detector, and the first wave would somehow stir up the second wave by some new process not yet known. That was essentially the implicate order, to say that the second wave was enfolded already, and would then?

**Wilkins:**

Enfolded in what?

**Bohm:**

In the whole, and would unfold into the part. Then after that it would spread out again, and do that again and again, and the picture of the particle would be constantly unfolding and enfolding. In and out. That was the picture I had in 1950, before I even thought of the causal interpretation, but I didn't develop it.

**Wilkins:**

So you didn't publish it.

**Bohm:**

No. I didn't even develop it. But it was already anticipating the implicate order. So I sort of already saw that quantum mechanics had that sort of thing in it. Saying that something was missing in quantum mechanics, essentially, they were only doing the first step, mainly letting the waves spread out, and suddenly saying, "Here comes a particle." But they were leaving out all these other steps of the process. So I said, "Quantum mechanics must describe a process." And Bohr says, "No process. That whatever it is cannot be described." The causal interpretation came close to Bohr because it had this manifest level of the particle in it, in which the observer needn't be mentioned. But it still did not have this implicate order fully because it just had the wave acting on the particle. The implicate order was a more fundamental view, I felt, of the meaning of quantum mechanics. Later I was able to show the connection between the implicate order and the causal, which we'll come to, many years later. So

those two views that I had in 1950 were actually closely related, but I only saw the relation after 1980. So I was developing the implicate order. And that time, there was a fellow called Donald Schumacher, who came as a student, a graduate student.

**Wilkins:**

What year was that?

**Bohm:**

It could have been about 1965. He was very interested in Niels Bohr. He was very good. He worked on trying to find out what Bohr meant. I had been working on it a long time, and I had written a book, which I tried to put Bohr's point of view in, in 1951. But actually, it wasn't. I think it was closer to Pauli's. Schumacher emphasized that Bohr was very careful with his language and was trying to present an unambiguous, a very careful way of using language. He balanced it so much that it's very hard to understand. Even in Princeton, there was a graduate student who said that with Bohr, he says that the meaning of what he says cancels out in the first approximation, that connotation cancels out in

the second approximation, and it's only in the third approximation that anything comes through. So you have to read Bohr very carefully. I think Schumacher made a very intensive study of Bohr, and he came out with what I felt was some understanding, which was that it had to do a lot with language, that Bohr was trying to develop a consistent way of putting the facts in quantum mechanics. It's very hard to make it consistent. Somebody like Von Neumann put it by saying, "The wave function represents the reality itself." And then suddenly, when a measurement is made, the wave function has to collapse, as I described to the particle wave. So it isn't making sense. When you follow that through, you'll find it's very arbitrary and very unclear what it means. Most physicists use it, but still it's a muddle. Von Neumann's language is a muddle. But most physicists don't realize it because they never analyze it. But you see, Bohr put it consistently. I think Schumacher's statement was that the form of the experimental conditions and the meaning of the results are a whole, not further analyzable. Therefore, the form of the conditions is described classically. Bohr emphasizes that the

experimental conditions must be described in the classical manifest world.

**Wilkins:**

In the way they operated, right?

**Bohm:**

That's right. And also, the result is described classically. But the meaning of the result must bring in quantum mechanics. It's only the meaning that makes it interesting. But the question is how are you to do this consistently? Because somehow, starting with a classical structure, you're jumping into a quantum meaning. What he said was that this is a whole. He said that because the quantum is indivisible, you cannot separate the quantum from the classical. The quantum of action is indivisible; therefore you cannot say there is a quantum level and a classical level. That's the sort of thing that Von Neumann said, but it gets into a muddle. So what Bohr says is that the distinction between this quantum and the classical is only a logical one. What that means is that it's not an existential distinction of saying, "This is here, and that's there." If it were existential, you would say, "Here is something

quantum, here is something classical, and they interact.” That’s what Von Neumann said. Now, Bohr said no, they are one whole because of the quantum of action. These are two terms appearing in that whole, the classical description of the conditions and the result, and the quantum meaning. He says the quantum meaning is only described symbolically by the mathematics, which gives the probability of the result. But you must have the complete experimental conditions. If you don’t put it all in, it won’t make sense. It’s got to be one whole. There’s a certain wholeness in this Bohr approach, which is not in the Von Neumann approach where he breaks it up in two where he makes the observer and the observed. Bohr doesn’t do that. He says that the experiment as a whole, the observer is out there, but it doesn’t matter. He’s just looking at the classical manifest level where it doesn’t matter what he does, and therefore he could be left out of the picture.

**Wilkins:**

Yes. But the observing apparatuses?

**Bohm:**

And whatever is observed are a whole. You introduce, however, a language which distinguishes the thing observed from the observing apparatus, but that is a form because you can only discuss the observed things symbolically. The electron can only be discussed symbolically, whereas the conditions are discussed by ordinary common sense language, and the result. But nevertheless, these two features of the language make a whole. That was his view. You cannot, then discuss the parts of that, in the sense of saying, “How does the result come about from the initial conditions?” Do you see?

**Wilkins:**

So you just sort of draw a blind down and say, “You can’t do that.”

**Bohm:**

He’s trying to say that the laws of the quantum theory are such that you cannot consistently try to do that. The very least he could say is, “If you don’t do it, but do what I say, you will be consistent.” He might also believe that there was no other way to be

consistent. I'm sure he did. I think that we became more clear what Bohr was about, that it had to do with a change in the way you use language. Because the physicists ordinarily said, "Our language is describing things as they are, and if two things are distinguished, they must be different." Here we make distinctions as a whole just for the sake of description, like form and content.

**Wilkins:**

So he is defining the nature of a barrier there which exists because you're using different languages on both sides of the [??]

**Bohm:**

Yes. He calls it a logical distinction, but I think it would be more accurate — I think Schumacher suggested it was a language question.

**Wilkins:**

So that seems clear. So he was making clearer the nature of the limits to the understanding of the total thing.



**Bohm:**

Yes. So he was saying that because of the quantum of action, there was an inherent ambiguity in the meaning of the result because you could only discuss it symbolically through the formalism as a probability.

**Wilkins:**

Having done that, where does that get you?

**Bohm:**

The least it gets you is to find out what Bohr was saying.

**Wilkins:**

So you have a clearer picture of what he was saying.

**Bohm:**

Yes. Because everybody plays lip service to Bohr, but nobody knows what he says. People then get brainwashed into saying Bohr is right, but when the time comes to do their physics, they are doing something different. That introduces confusion into physics. In fact, even Heisenburg and Pauli did not

do exactly what Bohr did. They all called it the Copenhagen interpretation, but then when you went on to Von Neumann, it was very different again, and various others. So there was a tremendous confusion that reigned in the interpretation of the theory, and it got worse as the number of interpretations kept on increasing.

### **Wilkins:**

I might interject that I heard from the American Academy of Arts and Sciences, they had a big meeting on Bohr, that they are going to publish what the papers there. So they'll probably send them to me at some stage because I'm a member of the team, and I'll let you have it when it comes to see what more interpretations are there.

### **Bohm:**

But that brought us into the question of language, and the discussions between Bohr and Einstein. There had been long discussions over the years between Bohr and Einstein to clear up these questions. They began by being very close to each other, and Einstein, when he first saw Bohr, he says, "I had a tremendous feeling of love for him," and

everything. They got along very well, but they could never agree on this question of interpretation.

Einstein's language was that he would get a unique description of reality so that the description was a direct reflection of reality, and the equipment would not play a part. It was not so much a question of whether there was chance in there, because although Einstein said, "God doesn't play dice," that wasn't the main point. The main point was whether you could get a unique description of reality. And Einstein took the ordinary view of a scientist that you could, and Bohr said you couldn't. Bohr said you were inherently limited to this use of the classical language for the experimental conditions and the results, and the symbolic mathematical description of the quantum.

### **Wilkins:**

But Einstein never provided a clear alternative to what Bohr said.

### **Bohm:**

No. He didn't accept that Bohr's approach could be taken as final, and Bohr insisted that it was.

**Wilkins:**

He was seeking one, but didn't find it.

**Bohm:**

No. But he first wanted to establish it made sense to seek it. Bohr would say, "It makes no more sense than to seek that two plus two equal five." Bohr essentially blocked the search, not to say that Einstein claimed he had it, but Einstein claimed it was worth doing, and Bohr said, "This is absurd." So Bohr was sort of undercutting whatever Einstein wanted to do and saying that there's no point in doing it. It's idiotic.

**Wilkins:**

Where does the implicate order fit into this?

**Bohm:**

Well, we have to come to that. The implicate order solves this thing, or even the causal interpretation solves it, but also the implicate order. I'll give you the causal interpretation first. It says that you have the particle and then you have the wave, which is more subtle. The wave is what I call a formal cause,

or information. To understand the causal interpretation, you have to bring in something like Aristotle's notion of formal cause, but I call it formative cause. See, Aristotle had the idea that there are four causes: the formal, the final, the efficient, and the material. Physics still recognizes the efficient cause and the material cause. The efficient cause is just; for example, the force that sets things going, and the material cause is the matter in which it works. Aristotle had the idea that the form that a thing has is a cause. Like, you say that the form of the animal is the cause of its growth, and if it has that, it has an end in view as it grows toward that form.

**Wilkins:**

Some sort of goal which exists?

**Bohm:**

Implicitly in the form. It already is a kind of implicate order. The seed is implicitly the plant. It unfolds into the plant. I think quantum mechanics requires that you introduce formative cause, and all of modern physics is dedicated to the idea that you must never think of it, but you must stick only to

efficient cause and material cause. Every one of the ideas, whether causal interpretation or the implicate order, brought in formative cause. And physicists violently — they really don't like it. They think it's absurd or unnecessary or whatnot. In the case of the causal interpretation was very simple. We had a particle, and it's movement was, first of all, in the first approximation just given by the classical potential, which depends only on the particles, and therefore you have what I call a manifest world self-determinant at approximation. The ordinary, common sense classical manifest world. You can leave the observer out of it because he can look at it without affecting it significantly. So that's a public world where communication has unambiguous meaning, and Bohr really emphasized that very much. "If you cannot know what your terms mean," he said, "your theory breaks down." Here in this classical world, we can have unambiguous meaning, and the causal interpretation does exactly the same. Now Bohr would say the quantum world is unpicturable, indescribable, and it is just simply symbolic, mathematical symbolism for the probability. I'm saying instead that the wave function represents a wave, but it acts not by its

intensity, but according to its form. It acts in a way which doesn't depend on the intensity. Therefore it's like a radar wave, which when picked up guiding a ship would act only according to its form. It doesn't push the ship around mechanically, but it is picked up and according to the form, represents the information of the environment and the ship moves accordingly. So a ship could be guided by a radar beam by saying that it's a bit stronger on this side than on this side, but the relative strength counts and not the absolute.

**Wilkins:**

And then the motion of the ship, you know what the mechanism is.

**Bohm:**

The ship moves on its own. But I'm going to propose now, the electron also moves on its own in a way that is yet unknown. This violates an assumption which scientists make that the smaller the particle, the simpler. But I'm saying that's an arbitrary assumption. There's no reason why it's so. There may be plenty of room for structure in the electron because between, say,  $10^{-16}$  where is as

small as they've gone,  $10^{-33}$  where you might have a gravitational cutoff is a tremendous range of structure. The same as you've got from  $10^{-16}$  to our size.

**Wilkins:**

So when the wave comes, the electron has some kind of thing that you don't know, like with a little radar and...

**Bohm:**

Or anything.

**Wilkins:**

Something you don't know which causes it to respond to the wave.

**Bohm:**

It responds to the form of the wave and not the intensity. The point is that's a formative cause, which is very common. If you take a radio wave, it's very weak and only the radio set responds to its form by its own energy. The computer does the same. The very tiny currents in the chips will affect much bigger currents in the machinery. And the DNA does



the same. The form of the DNA molecule is what the RNA and the whole cell responds to.

**Wilkins:**

In a sequence.

**Bohm:**

That's form. It's the shape that counts. So therefore, you have a formative cause. Then information in human beings works the same way, to inform, to put form into. And if you inform somebody, he will act according to the form of the idea. The form of the printed word is what counts and not the intensity.

**Wilkins:**

Why should anyone object to this idea, then?

**Bohm:**

They don't like the idea that anything like this is going on. They think the particle must be a simple mechanical thing.

**Wilkins:**

It's too small?

**Bohm:**

But at the same time, they're saying, "No. It's not a mechanical thing. It's something you can't picture at all." It sort of jumps around. On the one hand they say, "This is so mysterious, nothing can be said about it." And on the other hand, when the time comes to really think about it, they say, "It's a little ball."

**Wilkins:**

But the reason they say that it's so mysterious is because Bohr said so.

**Bohm:**

Yes. Or because they've been brainwashed into it.

**Wilkins:**

Yes. But it's to some extent the great influence of Bohr.

**Bohm:**

And Heisenburg, and Pauli, and some of the others.

**Wilkins:**

Right.

**Bohm:**

It's the whole period.

**Wilkins:**

Yes. So they've closed people's minds to such [???].

**Bohm:**

Yes. See, Heisenberg emphasized that no picture could be made under the atomic domain. It had to be just mathematics. So now you can say that the electron can be understood as a formative cause, and we say now that the manifest level is affected by a more subtle formative level. We can touch the manifest world because our own bodies are also in the manifest world, and they interact in that way. But we don't directly touch the world of the wave function, only indirectly. But our own minds also work in a similar way; the form of our thought will affect what we do. So I'm saying that's the subtle world. I'm not identifying the mind world with the wave function, they're related, but I'm saying that

the general picture is in addition to the manifest world, we have many levels of subtlety. The subtle world affects the manifest world, and the way we find that quantum mechanics is needed is to discover things that are happening in the manifest world that are not explained by the laws of the manifest world, and we say that there is a subtle wave function which changes it. You also do the same thing with people and the way you attribute mind to them. So I agree with Bohr in many ways, and disagree in other ways. I saw we agree on this manifest world without the observer needed. I say that we can form a picture, an idea, of how the subtle world works in the manifest world, and he says, “No. It cannot be done. You can only have the algorithm. You can only have the symbolic treatment.”

**Wilkins:**

But if you took this idea to Bohr, what would his response be?

**Bohm:**

He would say that these particles are not necessary. When you bring it to him, the first response would be, “Why are you inventing all of these particles?”

They don't add anything to the experiment." If you apply Bohr's rules, we will predict a certain result, and using these, we predict the same result. Of course, I say these particles might obey different laws, and therefore, there might be some room for something new, but we haven't reached it yet.

**Wilkins:**

I'm lost. Which of these particles?

**Bohm:**

Which I've suggested. See, I say an electron is a particle affected by a subtle wave. Bohr would not say anything about what the electron is, but if he just says we have this classical manifest world, and we applied the rules of the algorithm, we would get the probabilities right for the experiments.

**Wilkins:**

But this subtle wave, you mean as a particle associated with the subtle wave?

**Bohm:**

The other wave, the subtle wave is associated to the particle.

**Wilkins:**

You've got the electron, but you've got another kind of particle.

**Bohm:**

No. I'm saying we've got to turn the language around. People have gotten so used to saying that the electron is a wave function, that they always assume it. I'm not assuming that. I'm saying the electron is the particle which is affected by the subtle wave function, so it behaves differently from what you would expect. Just to say a human being is a certain structure, but he is affected by something subtle in him which makes him different than just a collection of machinery.

**Wilkins:**

I've got the idea that you're saying the electron has properties that people would not think it reasonable to associate?

**Bohm:**

Yes. As a particle, it has those properties, but in ways we don't know.

**Wilkins:**

So the main thing you're saying then is that the electron has special properties which normally are not attributed to electrons.

**Bohm:**

Not to any kind of particle.

**Wilkins:**

To any kind of particle.

**Bohm:**

And one of the properties is that it can respond to this subtle wave. But the electron is never separated from the subtle wave, so what we call the electron, its behavior depends on that subtle wave, except that in the classical limit, its effect is so small, you can neglect it.

**Wilkins:**

But you were talking earlier about these particles, but the only particles you're talking about are the electrons.

**Bohm:**

That's right. Yes. But I'm starting from a different assumption, and usually people say the wave function is a complete description of reality, but the wave function is only symbolism.

**Wilkins:**

I see. You're starting off with the idea of a particle electron which has special attributes.

**Bohm:**

Yes. And along with it is a subtle wave. And that subtle wave will bring about a wholeness of the electron with its environment, just as the subtle mental properties of human beings will unite them with their whole environment.

**Wilkins:**

What you've got then is a coherent description of the whole process.

**Bohm:**

That's right. Yes.



**Wilkins:**

And you still end up with probabilities?

**Bohm:**

The same. Except that this process has a different concept, so I have room in there to change the laws so they're not exactly the same as quantum mechanics. I can make them the same, or I can make them different. But in quantum mechanics, you can't change them.

**Wilkins:**

But there's no point in making them different.

**Bohm:**

No. Not yet. But there's room if ever an experiment came up.

**Wilkins:**

So you're idea explains all the known experiments, might explain other ones in the future, but also gives a coherent description of the total process, which had been lacking previously.

**Bohm:**

Yes. It contains the feature of consistency in Bohr's approach, which it aims to set up. In other words, that you actually manifest at a classical level where you don't need to consider the observer. See, that was confused before. Before Bohr brought that in, people were always bringing the observer directly into the theory, and what does that mean? And they still are with Von Neumann.

**Wilkins:**

But most physicists are not necessarily interested in this coherent description because they managed to get along, they feel, quite well without having a coherency.

**Bohm:**

Yes. They got their results, and they say that's the main point. They say, "What's the use of bothering with this"? But that's a different approach as to what you mean by physics. As I said, physics consists of getting results which you compare with an experiment. That's all. Anything else must only serve that.

## **Wilkins:**

So as you say, there's always the possibility that some new result that could come up, which couldn't be explained by quantum mechanics, and your theory might be [???] for that.

## **Bohm:**

Yes. So the implicate order only appears here in the sense that the subtle level follows the implicate order. It's a wave which unfolds and folds. So we would say that's a matter that fits with our common experience, say, with human beings. The manifest level follows the explicate order, the body and so on, but the way people behave and the interaction through the mind follows the implicate order because the un-foldment of thoughts. See, each person unfolds the whole surrounding, so you will see them behaving by taking into account everything. If you tried to say that there are various forces in the environment that are pushing them around, they wouldn't understand it. Because people go around taking into account everything in very complex, unpredictable ways, which show that his hand folds the whole environment, which is inactive

in him as a formative cause. So that's the jest that between inanimate matter and animate matter. The difference is not absolute.

**Wilkins:**

You then say that this thing about the formative wave is equivalent to the implicate order idea.

**Bohm:**

Well, it's part of it. The implicate order goes further, but it contains some of the implicate order idea in the sense that this formative wave unfolds the whole environment, and the particle responds to it. The implicate order idea goes further because it says that perhaps even the particle structure itself might unfold from the environment.

**Wilkins:**

But it's just an extricate form.

**Bohm:**

Yes. And in fact, something like that was achieved later when we thought about applying this interpretation to the quantum mechanic field theory, where the basic reality is now not a particle, but a

field. But then there's a super wave function applying to the whole field, which acts as a formative cause on the field. When that can be neglected, we just get Maxwell's equations, so waves spread out. But when it's not neglected? As I said, I didn't get a lot of resonance on this whole thinking from physicists. I don't think that they could see why I was interested in this, most of them. They said, "What's the need for any of this?"

**Wilkins:**

"It doesn't enable us to do anything we couldn't do before in the way of explaining existing results."

**Bohm:**

Yes. Being able to calculate.

**Wilkins:**

It wasn't all that encouraging then, was it?

**Bohm:**

No. They also didn't see any new mathematics, and they said that mathematics was the main thing that interested the theoretical [???].

**Wilkins:**

They would have been more impressed had it been new mathematics.

**Bohm:**

Yes.

**Wilkins:**

But you did find it discouraging?

**Bohm:**

Well, one point was that it was somewhat discouraging, but it didn't affect me very much because my interest had gone so strongly toward Krishnamurti that physics was not the only point of my life at the time, not that central, so I could say, "I'll keep on working on it," because I had other interests.

**Wilkins:**

The reason I ask this question was that I saw a little bit of the end of a life of Turner program on the television last night, and apparently towards the end of his career, he got a lot of very negative responses

indeed to his painting, and apparently this did discourage him a lot. I thought, “Well, why didn’t he know, as some painters do, that what he was doing made sense? Why did he worry?”

**Bohm:**

You can never be sure that it’s right, and the other point is, at least I don’t know about the painting, but it’s essential in science that it’s a public activity which requires participation together as for its meaning. There’s not much point in putting something out if nobody pays attention to it ever.

**Wilkins:**

That’s quite true. But to some extent, you might say the same thing about art, mightn’t you? But I think that art has sometimes too managed to sustain themselves at their own sort of [???].

**Bohm:**

At least the artwork has more of an individual meaning. But any scientific work, it’s meaning is only as a communication, as something which is shared.

**Wilkins:**

Yes. You mean it's more like a brick in a structure or a house or something.

**Bohm:**

Yes.

**Wilkins:**

That's true. I suppose you're right. In both cases, you have the feeling that you can't be sure you're right.

**Bohm:**

Also, at the time, I remember I gave talks on the implicate order to all sorts of people, like artists and architects and so on, and they appreciated it. See, that all helped. They could all get interested in it. The physicists couldn't because they said, "It has nothing to do with physics."

**Wilkins:**

Yes. The artists had sort of wider philosophical sort of interest.



**Bohm:**

I remember there was this student of mine, Jeffery Bub, and I gave a talk on the Seven Days in Tel Aviv on the implicate order, and he said what happened was that the standard form of talks in physics exist of everybody gives his so called philosophy in the first ten minutes, and then he starts putting down formulas. So people remain asleep until they see the first formula, and then they wake up. So I kept on talking and talking, and looked there, and they remained asleep, and then toward the end, they finally realized it was too late, that they'd missed the talk. There is that tendency to fall asleep because usually, what they call their philosophy is a vague set of statements not very well considered.

**Wilkins:**

Really what they say in the introduction is going to be articulated more clearly in the mathematics.

**Bohm:**

Yes. That's right. Or in fact, often it doesn't even have much to do with it. So people say the real stuff

comes with the mathematics, the other stuff, as I used to say, is the “icing on the cake.”

**Wilkins:**

But if you were really to go deeper into the nature of American science, then ultimately there isn't any difference, although there is a sort of quantitative difference of emphasis in the way it organized. But ultimately it's got to be a matter of embracing all the [???]. Any meaning from artistic work has got to relate to some kind of universal in humanity. In that sense, they aren't different.

**Bohm:**

Ultimately, they must be related.

**Wilkins:**

But I can see that in a limited sense of how people work, it's not different. I think it's this question about some people think that art is subjective and science is objective, but I think this was brought up clearly to me in reading about Chekhov about how he worked and dealing with things that are normally considered at the subjective level. How a work of art can actually be very objective in working and in

constructing. He had to be very objective, just like a scientist.

### **Bohm:**

Anyway, this involved a considerable extended question of language. You can see the way the language in the way in which we were approaching it. Bohr had one language and Von Neumann had another language, saying that the wave function was a complete description of reality, which it mattered to a certain use of language. And that led to the idea of its collapse. So I was proposing another language, and I didn't have it fully developed, but I could put it how as the manifest and the subtle, the implicate order and the explicate order, which is quite different. The basic language of physicists has been that everything should eventually be reduced to the manifest, and what is inside a thing is only some smaller bits of the same sort of thing that is outside, fundamentally.

### **Wilkins:**

This was breaking down once they got on to ether, and breaking down as much in the [???], wasn't it?

**Bohm:**

Yes. But it's still the language which is used. Everything is made of atoms, which are essentially the same as the common sense view, the manifest view. To say that the only reason that it's not manifest is it's too small to be seen, but if you just magnify it, then its manifest.

**Wilkins:**

What about a field? How is that manifest?

**Bohm:**

Well, that's a bit more subtle, but it manifests in the atom. They will carry it one stage further, but then it's like the wind, manifest in the trees, and some scientists wanted to say there were ether particles carrying the field, but others didn't want to. But it doesn't go very far. The field is only a small step away from the manifestation.

**Wilkins:**

Yes. But you mean you can push an electron in a field and that makes manifest the field.

## **Bohm:**

Yes. And at the same time, the field is what makes the electron manifest by the waves that it scatters. So they manifest in each other in a way. But they're both still not all that different. In the quantum mechanics we have a formative cause. See, both are similar in the sense that they both depend their energy for their effect on the force in energy rather than on form. When we get to the formative cause, it cannot be considered to be a part of the system, which is just exchanging energy and force with the other parts, as the field can be thought of exchanging energy with the particles. So the formative cause operates differently, and in the same way, you can't say that the mind is exchanging energy with the objects in the environment, conserving and so on. So there was a different use of language. Through my discussions with Schumacher, I became very aware, I have to say first of all that Einstein's use of language and Bohr's were in collision. They couldn't agree. Einstein took the view essentially of the manifest world but subtle enough to be a field. Bohr said that there is subtle world, but it can only be discussed symbolically and no more can be said about it. So between Einstein and Bohr, they never

could agree on what the problem was. Einstein kept on bringing up objections to the quantum theory from hypothetical experiments, and Bohr always answered them, thereby apparently proving that Einstein was wrong. That wasn't the point at all. The point was that Einstein had one view as to what kind of language would describe the truth, and Bohr had another. To Einstein, Bohr had what he called the tranquilizer philosophy. He just said that Bohr was avoiding the question of trying to give a real explanation.

### **Wilkins:**

But then when Einstein described the hypothetical experiments and then Bohr explains the...

### **Bohm:**

Well, Einstein didn't accept his explanations, essentially. In the case of weighing a proton, he gave a good one. But when it came to the Einstein-Rosen-Podolsky experiment, then Einstein would never accept Bohr's explanation. He said that what Bohr called an explanation was actually an evasion of the issue. Bohr would say Einstein was turning in a reactionary way against his own insights in the

theory of relativity. So they were really at cross purposes. The point they were arguing about was not the point they were talking about. The point at issue.

**Wilkins:**

So your point is that if they'd had more extensive dialog, they might finally be able to realize what they really were arguing about.

**Bohm:**

Yes. The point was that they had different notions of language and truth, and so on. Einstein said that you must have a complete description of reality in the quantum mechanics as incomplete from the Einstein-Rosen-Podolsky experiment, he gave an argument proving to his satisfaction that the wave function did not give a complete description of reality. Bohr's argument was a very subtle one. What he said was that there was no meaning to what Einstein was doing. Unless you discuss the whole experimental arrangement and the symbolic meanings of the formulas, then there's no meaning. In order for Einstein to discuss what he discussed, he would not bring in the whole experimental arrangement. In my book, I developed it in terms of two particles with

spin. If you measured one particle, the other would always have the opposite spin. Now, Einstein would say, “If you measure one particle, then you can predict with certainty what the other one has, but without interacting with it.” He said, “If you don’t interact with it, and it’s found to have that value, then it must have had it anyway.” Einstein said that you could do that with one spin or the other, X or Y, which didn’t commute, which are not supposed to be observable together. You would then say that at least in the other atom, which didn’t interact with the first, the values were there, even though you couldn’t measure them together, and therefore quantum mechanics was incomplete because it never could describe the values being there together. Bohr said that was a misconception because he said there was no meaning to this experiment unless you put the whole arrangement in, which included not only measuring this spin, but measuring that. But Einstein was talking about what that atom is when it is not measured. So I sense that makes perfect sense in my view because there is a unique reality that doesn’t have to be measured, and Bohr said you are simply using language wrongly and meaninglessly, and going back on your insights on relativity where you



say that every measurement depends on the context for what it means.

**Wilkins:**

Roughly, what year was that?

**Bohm:**

Well, at 1935.

**Wilkins:**

Were they doing this by letter?

**Bohm:**

No. What happened was Einstein wrote a paper, and Bohr would have to answer it. The story was that Bohr got a copy of it pre-publication. He got a copy of this paper and it worried him, he went to a point of sleepless nights before he devised an answer. But Einstein said there was no answer, it was just a tranquilizer philosophy. Bohr said his objections were pointless, that they were turning against his own revolutionary advances in relativity.

**Wilkins:**

And just give up?

**Bohm:**

They kept arguing and arguing, but they just repeated their arguments and gradually, they gave up. The story is that many years later in the 1950s, Einstein and Bohr were at the Institute for Advanced Study in Princeton, and they never met, in spite of their closeness many years before. So finally Herman Weyl, a mathematician, thought they ought to meet, and he arranged a party for them and their students. In this party, Bohr and his students appeared at one end and Einstein and his students at the other end. They still didn't meet because they couldn't talk to each other, there's nothing to say.

**Wilkins:**

And they were embarrassed.

**Bohm:**

Yes. Because they talked and talked and talked, and they knew that they would just simply say the same old thing again.

**Wilkins:**

So they didn't feel it proper that they should just be together and talk about it, have a cup of tea or something. They thought this would be somehow?

**Bohm:**

Well, this question was always in the background, worrying things.

**Wilkins:**

Right. It would be too artificial.

**Bohm:**

Yes. So therefore, they didn't meet. The point was there were two ways of using language and two explanations and two sets of assumptions, which they never explicitly put in there for they didn't know what they were arguing about.

**Wilkins:**

Okay. But in a dialogue situation, however long it went on, it's like Hegel's or Lenin's right conditions. Presumably they never achieved the right conditions.

**Bohm:**

Well, they weren't doing a dialogue. They were not discussing the point which was the unconscious assumption, or even conscious. But they did not discuss their assumptions. They argued by saying, "This is my assumption. This is my result." They did not get together and say, "Here are our two assumptions. Let me look at your assumption as favorably as I can, and you look at mine."

**Wilkins:**

Yes. But aren't you slightly pre-judging the whole thing because in a dialogue, you cannot specify the right way for dialogue, you just have to start off.

**Bohm:**

Yes. But unless that happens, it will be quite useless.

**Wilkins:**

So the right conditions. But in every dialogue, presumably, where you have?

**Bohm:**

But one of the conditions would be to understand the way a dialogue has to operate. If you understand dialogue as simply exchanging your opinions and sticking to them, then you will never meet.

**Wilkins:**

So what you're saying is that it was an ineffective dialogue because it had a blocking and a lot of confrontation or limitation.

**Bohm:**

Yes. Which meant that they did not understand that the dialogue was called for and what that would mean. So they took it as an argument on scientific merit, but the problem was on another level.

**Wilkins:**

This surely is typical of all kinds of confrontations in dialogue, which people have to make some sort of creative leap at some stage to see the terms in which they're looking at the whole problem are inadequate. Isn't that right?

**Bohm:**

Yes.

**Wilkins:**

So what they were doing is just one example of what happens if. There's no rule for attaining an agreement through dialogue, is there? You may analyze being...

**Bohm:**

No. But you can, and people become more aware of it, that what is needed is a dialogue and they'll have to listen to each other's assumptions.

**Wilkins:**

You mean you could say to them, "You can set up rules to some extent for helping to generate a dialogue," and instead, "Did you look at that little book which I lent you at all?" That is trying to do that, to some extent. But it's like being creative. You cannot train people to be creative, but you can set some indicators about the sort of way that you proceed, and no more that.

**Bohm:**

I didn't realize that what was called for was to do this, but they took it to mean that they were just arguing about scientific questions.

**Wilkins:**

So that if a third party had been there and understood it properly, if you had been able to go along there and point this out to them, and they were prepared to be patient about it, they might then have been able to proceed.

**Bohm:**

Yes. They've got to perceive that they are arguing about premises which they are accepting.

**Wilkins:**

If either both of them or one of them had had sufficient energy to persist on the whole thing, it might have struck them.

**Bohm:**

Yes. It was no use to repeat the argument. What they had to do was to focus on the premises and bring

them out. The causal interpretation helps show what the argument was about because in the causal interpretation, we have exactly Bohr's requirement of a manifest world where you get your results, but we have a subtle world which is affecting the manifest world. Since Bohr had no clear picture of that, he could not communicate it to Einstein. He could only talk about the symbolic. So it is absurd to say that a symbolism affects the real world. The issue would have been that there are two levels to this real world. One is the manifest level, and the other is the subtle level. Einstein is saying that it's all one level. That was the real issue.

### **Wilkins:**

So he was just skipping over one essential part of his.

### **Bohm:**

But you could not bring that out at that time because I think that the attempt to put it as Bohr put it made it so vague and so difficult to put, that Einstein could never have understood it in those terms. Einstein could have understood, I'm postulating a subtler level than you are. But Einstein cannot understand



saying, “I am not postulating anything. There is another level, but I am only discussing it symbolically, and logically, and not discussing it.” Einstein could never have understood what Bohr was driving at as long as Bohr put it in those terms, because he more or less was unable to say whether there was a reality or not a reality.

**Wilkins:**

If Einstein was properly conscious of the terms in which Bohr was putting it?

**Bohm:**

But it was exceptionally hard. I studied this thing for many years, I wrote a book on it, and I talked it over with Schumacher, and whatnot, and it still really wasn't all that clear.

**Wilkins:**

But doesn't this simply illustrate the fact that if you're arguing from two different positions, or having a dialogue or something, there may be considerable difficulty in making the necessary creative leap, because it may involve some type of

mental operation which is different from the whole nature of the [inaudible].

**Bohm:**

But it means listening to the other person's view favorably for a while, and trying to really put it in the best possible way.

**Wilkins:**

Do you mean that if Einstein had worked very hard to put himself in Bohr's shoes?

**Bohm:**

And the other way around.

**Wilkins:**

And the other way around. You that's what might have been sufficient?

**Bohm:**

It could have helped. Einstein found it very hard to go into Bohr's shoes because he said there was a unique reality. That was his premise.

**Wilkins:**

So in effect, we might say that it was almost a lack of courage because it's this sort of thing that you need surely to do this. When you think that someone else is unreasonable, it can be quite frightening to try and put yourself in that position.

**Bohm:**

Bohr was saying that Einstein was an old fuddy-duddy sticking to that simple view of reality.

**Wilkins:**

I think it's the sort of courage which is often what the younger people find easier because they haven't got all of their background of commitment and lessons of their whole life's work. They've got less to lose.

**Bohm:**

Yes.

**Wilkins:**

Then you published these things?

**Bohm:**

No we didn't. The trouble was that we wrote something on Einstein and Bohr together, Schumacher and I, and Schumacher then broke down. He was rather unstable and he broke down into paranoid schizophrenia and he was hospitalized, and before that, he was getting all sorts of disturbed reactions to this. He went against it and he began to change it into an incomprehensible thing, and it became impossible to do anything with it.

**Wilkins:**

Do you think that this might have been?

**Bohm:**

No. I think the problem was with Krishnamurti, who introduced more than him. But I think fundamentally, he had a whole history. We went back and found out later, from an early childhood.

**Wilkins:**

Did he have connection with Krishnamurti?

## **Bohm:**

I brought them together and so on. I thought maybe Krishnamurti could help it, but it turned out he didn't, and it may have made it worse. So you can see that there are many questions of communication that were involved all around Bohr and Einstein, and between Donald and Krishnamurti, and so on. So I became very interested in this question of language through all of this, even before all of this had happened, and I could see that this question of the use of language must play a big part. In fact, Heisenberg and Bohr had set physics off in this mathematical usage of language saying that the essence of science is in the equations, and that mathematics just satisfies equations, then he pictures are no longer possible. That was totally against Einstein's way of using language, and of course, a great many other physicists, including myself. I felt that there was something in what Einstein, and there was something in what Bohr said, and we had to somehow include both and get beyond both. I think that the implicate order did, and the way I explained. It includes Bohr's notion of that manifest world, but it goes to a subtle world, which is at least something

Einstein would have understood, though he might have rejected it.

### **Wilkins:**

So what you're saying is that in effect, you made a synthesis of two important points of view, but the ordinary died in the wool physicist would simply say that you made a diversion by cooking up a misguided Einstein sort of notion which wasn't necessary because they didn't see the need for it.

### **Bohm:**

They had no notion of what Bohr was saying, and they had some vague notion of what Einstein was saying, but no notion of what Bohr was saying. They didn't see the need for it as long as they could do their computations. So the whole thing was really not understood by physicists, and no attention was paid to it. In addition, there was a fellow at Bath University that did a sociological study of this. He gave evidence where he thought there was a systematic attempt to prevent the causal interpretation from being taken seriously on the part of physicists like Heisenberg and [??] and so on. They allowed the papers to be published, or just put

out that there was nothing in it, since they function as an authority.

**Wilkins:**

Which papers were those?

**Bohm:**

On the causal interpretation.

**Wilkins:**

And you published that yourself?

**Bohm:**

Yes. The first one was in 1951, and then we published others later.

**Wilkins:**

So that these papers were somehow there, but not there.

**Bohm:**

Yes. The word got around that there was nothing in it, and people were very prone to accept authority among physicists.

**Wilkins:**

So I think this is a common thing in science, that people say, “Oh. We’ve seen this thing, and there isn’t anything in it.” And then you seek guidance, and then they repeat this. It’s just ignored really, unless you have someone who is ignorant who isn’t in the know, who then may be innocent enough to pay attention to it. So only the ignorant people have the advantage then.

**Bohm:**

That was one point. And then in the development of the implicate order, I was trying to bring together the mathematics and the physical ideas, saying, Okay. Let’s take all of this mathematics of [??] space. Let’s try to understand what it means. It means this unfoldment. And in my later language, it means the subtle level acting in the manifest.

**Wilkins:**

By the way, about the sociological, did the chap publish it?



**Bohm:**

I don't know. He sent me a copy of it and it's now lost. I don't even remember his name. But he probably published it somewhere.

**Wilkins:**

Because it would be an interesting study of the sociology of science, because I don't know that they much study that type of thing in contemporary science. I think people do it sort of in the past, some distance in the past.

**Bohm:**

Yes.

**Wilkins:**

Why was he stimulated to make the study?

**Bohm:**

I don't know. He found it an interesting phenomenon.

**Wilkins:**

Did you know him?

**Bohm:**

No. He did it by himself.

**Wilkins:**

So without any contact with you, he just saw this paper in the literature?

**Bohm:**

Somehow he learned about it and he said, “Why isn’t attention being paid to it?”

**Wilkins:**

In fact, being an ignorant outsider, which enabled him to see that there was a question, whereas the physicists wouldn’t have seen that there was any question as they had an answer already.

**Bohm:**

Well, they had an answer and in the beginning, it was primarily the big shots that put out the word. Then later people got so used to repeating the word that it became the accepted wisdom. A long time ago, Von Neumann made that statement that physics is organized like the Church. It’s got a pope, and

cardinals, and bishops and so on. He said he would put himself as a cardinal, if I can remember, or a bishop. I don't remember which. It's organized hierarchically and authoritatively. Of course, they don't formalize it. Everybody pretends it's not there.

**Wilkins:**

But it functions nonetheless.

**Bohm:**

Yes.

**Wilkins:**

Von Neumann was then dead, wasn't he.

**Bohm:**

By that time? He was dead by the 1960s. He may have been alive, but I don't know. I didn't contact him. So I was interested in trying to somehow synthesize the mathematical approach with the intuitive approach. That I do, even to this problem in Berkeley, why I felt people insisted. They didn't want any intuitive understanding. They only wanted mathematics when I thought I might quit physics. I thought the way out of that would be to weave the

two together, but it was successful in writing my book in quantum theory, and here it went too far beyond what physicists would be ready to accept. So I didn't reach the physicists.

**Wilkins:**

You mean as a published paper in the physical journals, it didn't?

**Bohm:**

Well, some physicists may have paid attention to it, but it didn't ever get to the point where people would ever really take up the issues.

**Wilkins:**

Paid serious attention to it. Yes. So it's a little bit like the people in the Middle Ages who didn't pay attention to Menova [?] or something because they didn't fit in with established patterns and their view and they didn't make any note of it. But you could see that they were there, but you could say, "So what? Forget it." So you don't know where the sociological paper was?

**Bohm:**

No.

**Wilkins:**

Do you know any way of finding it?

**Bohm:**

I don't know where that fellow is now.

**Wilkins:**

There ought to be some analyses of titles of papers of something.

**Bohm:**

I can't remember the title, either.

**Wilkins:**

What I'm getting at is theoretically with all of these data storage on computers, that they have descriptions of titles, and they ought to be able to pick up a phrase? In the title, there would be something about what was the title of your paper? You know, those?

**Bohm:**

Yes. But I don't know if he repeated that.

**Wilkins:**

But it might well be. What I'm getting at is that I would have thought it would be interesting if the paper could be traced?

**Bohm:**

Maybe we can trace it through Bath University.

**Wilkins:**

Yes. Do you know what department it was in?

**Bohm:**

Well, obviously sociology or something like that. One of those departments.

**Wilkins:**

Do you know roughly the year?

**Bohm:**

Yes. I can remember that.

**Wilkins:**

Well, the number of papers published from that department in that year won't be very big.

**Bohm:**

We might have four or five years to go from.

**Wilkins:**

But even so, it wouldn't be a big task, would it?

**Bohm:**

No.

**Wilkins:**

And you don't remember the man's name, but it ought to stand out, if it's something about physics, in the title. I think it would be an interesting point to put it in the book.

**Bohm:**

Yes. It would add something.

**Wilkins:**

Yes. Because I think the more sort of dimensions that you put in a book, like sort of graphic illustrations and evidence from sociological study and all this type of thing, I think it adds to the interest.

**Bohm:**

While I was working quite seriously during that period, I was also not considering it to necessarily be that important because I was so interested in Krishnamurti, so it didn't affect me as it might have.

**Wilkins:**

If that had been your sole activity, then it might have thrown you a bit.

**Bohm:**

Yes. One of the things that came up with language is what I call the real mode. To try to develop a language which would emphasize process through the verb, rather than the noun. That was part of this whole interest of mine. The idea was that our language is too attached to nouns and objects, and this makes it hard to describe process. We have the subject, which is a noun, acting on the object, which



is a noun. The verb is only a kind of relation between the subject and the object. Or the subject acting on itself, reflexively. I wanted to make language where the verb was the basic idea, movement, and this would tie in with all the other things I was saying. Perhaps we will discuss that in more detail another time. I worked out this reel [?]. I gave two talks at the Institute of Contemporary Arts, which were quite [??] followed by the...

**Wilkins:**

What year was that?

**Bohm:**

I can't remember now, but it could have been when [??] was around. I don't know.

**Wilkins:**

1970?

**Bohm:**

Before that.

**Wilkins:**

1965?

## **Bohm:**

Between 1965 and 1967 or 1968. I was very interested in the question of thought and why it was so restrictive. It was holding us back in limited ways, and this pattern with Krishnamurti, and the emphasis on how thought was going wrong and making us so much trouble. So one approach was to get more insight into language. This was really inspired by Schumacher and his interest in language. It was unfortunate that Schumacher did not manage to interest Krishnamurti in the language for all around. It would have helped Krishnamurti, and it would have helped Schumacher. You can see that there really is a breakdown of language in physics, between Bohr and Einstein, between those two and Von Neumann, and some of the others. Interpretation has come along. Each one of these interpretations is using basic language in a different way, making different fundamental assumptions, but in effect, some of these various assumptions are dismissed by various physicists, you know, tacitly just as they don't like the way that the leading physicist said nothing in the causal interpretation.

**Wilkins:**

So the nature of the assumptions they don't pay attention to.

**Bohm:**

They've their own assumptions and if you remember what was said, this last thing with Demaries [?], something that like violence is the voice of the unheard. That's a phenomenon in society as a whole, that people pay very little attention to other ways of thinking or people who have different assumptions.

**Wilkins:**

Yes, but the physicists haven't become violent. Do you mean it was a form of violence for them to be setting up the authorities to suppress people from thinking about such violence?

**Bohm:**

Yes.

**Wilkins:**

But that's violence from the wrong end.

**Bohm:**

But I meant that we're not really using rational communication, but they were just simply imposing certain views in a way which didn't even make any arguments, but just said there's nothing in it. The only person that ever made an argument was maybe Heisenberg, but it wasn't a very good one, I think.

**Wilkins:**

You mean if the voice unheard were to face the fact that it was unheard, and understand the situation in which the voice is being unheard, then they would find some other way of approaching the situation other than being violent; whereas you mean what was lacking here was the physicists sitting down and looking calmly at the type of problem they had.

**Bohm:**

Yes.

**Wilkins:**

But they were just being kind of uptight about it.

**Bohm:**

Yes. Naturally, the thing was not as clearly put then as I can do it now. Still, what was called for was to discuss openly rather than to just say, “Don’t listen at all.”

**Wilkins:**

That requires a motivation and interest in the nature of the problem, doesn’t it. But sometimes people lack the motivation because they sort of scare themselves off.

**Bohm:**

Yes. I think things have gotten more and more complicated. People said that first of all, there’s nothing in it, all the leaders have said so. Then it began to get passed from one generation to another, there’s nothing in it. It became part of the tradition, the way we’ve always thought. Meanwhile, people have gone on to more and more mathematical ways of doing things with super-symmetry and strength and various things, where there’s not only no physical concept, but their connection with the experimental is very distant, too. It may be 20 or 30 years before they can hope to connect with experimental. Somebody was telling me they’d had a

meeting over here to celebrate Schrödinger's anniversary here in the Imperial College, and then talking about all of these silver strings and such. First of all, it's ironic because Schrödinger would have been the least person. He even said that he was sorry he had anything to do with the quantum theory and the way it turned out because it had given up physical insight.

**Wilkins:**

Did he see physical insight in the idea of the wave equation?

**Bohm:**

That's right.

**Wilkins:**

This was something you could visualize.

**Bohm:**

Yes. That was his purpose in doing it, and then we he saw it, turned the other way. He said, "I'm sorry. I didn't have anything to do with it." Then Heisenberg said that what Schrödinger did was rather unimportant, and [???] use technically. The

main insight was that you couldn't visualize it as far as Heisenberg was concerned, and Schrödinger was really quite off the beam in trying to visualize it, but he turned out to produce a useful way of calculating.

**Wilkins:**

But the mathematics were equivalent.

**Bohm:**

They were. That was a useful way of calculating things, easier to calculate than Heisenberg. But Heisenberg felt his way was the real way that showed the way things were, and Schrödinger was just sort of a useful way of calculating.

**Wilkins:**

In the event, people found Schrödinger's way of doing things much more fruitful.

**Bohm:**

Yes. That's right. But there is some physical insight in there, even though people deny that it's there.

**Wilkins:**

The mathematics were equivalent. There was really more sort of go in Schrödinger's approach.

**Bohm:**

Yes. So they smuggled physical insight in that way. But Schrödinger even said that he was sorry he had anything to do with the whole thing.

**Wilkins:**

I have a vague memory of something about an undergraduate, something about Heisenberg and matrices or something. This didn't ever mean much to me, and I found this sort of very arid. And then when the Schrödinger thing came along, I could say, "Well, it's doing this," and I thought fine. It was that kind of difference. I think I was very attached to thinking in physical terms.

**Bohm:**

When you finally end up, you can't really picture the shredding or the wave. You'll have to picture it as the subtle level rather than a wave in the manifest. The point is that because you couldn't put it in the



manifest level, and because people were saying that if you were going to picture it, it's got to be in the manifest level. Therefore, it inevitably went to Heisenberg, who said, "No picture. Only formalism."



## Interview Session – 12

**Bohm:**

Well, last time we were discussing, among other things, the question of the failure of communication between Bohr and Einstein. Remember that?

**Wilkins:**

Yes.

**Bohm:**

And my student Schumacher, who was very interested in this question of communication. And the fact is that we wrote a paper, which we didn't publish, on the failure of communication between Bohr and Einstein, in which we actually said that they should have had a dialogue between them rather than just each — if we said that each one had his own notions, which we now [??] total assumptions about the nature of truth, and each one excluded the other and that they were arguing across purposes because they never discussed that basic assumption. They seemed to be discussing scientific questions.

**Wilkins:**

I think your point here, it relates to the Thatcher/Gorbachev discussions and you had said that if you wanted to understand the other person's point of view, their presuppositions, you might have to go away and do some reading. I don't think that Thatcher, for example, as reading up Marxism Leninism.

**Bohm:**

Oh, you have to really understand it. I mean remember what we were saying about cherishing all the ideas and really looking at them carefully and giving them value before you —

**Wilkins:**

It's a bit like role playing, in fact. You have to really act as though you were a Marxist Leninist.

**Bohm:**

Yes, or else as a capitalist. And there's whatever idea you are studying, you've got to take that role at that point, cherish that idea, give it a high value and really have enough motive and incentive to really

study it and try to work it out, try to improve the other person's presentation.

**Wilkins:**

Yes, even make the other person's base better than he made it himself.

**Bohm:**

Yes.

**Wilkins:**

Yes, I think this brings out the fact that this type of dialogue can be really a very immense undertaking.

**Bohm:**

Yes, we sort of suggested that Bohr and Einstein really should have done that, which was the only way out of their impasse.

**Wilkins:**

Presumably, if you had such extremely open minded and —

**Bohm:**

Well, they're also full of goodwill.

**Wilkins:**

Yes, you mean the goodwill was very important. And if they failed, it does show how intrinsically difficult this sort of operation can be.

**Bohm:**

Yes. So that was one point. I think that, see, for example, I'm now thinking of going to a conference in Finland in the summertime on the philosophy of quantum mechanics. It turns out that the people, who are going there, mostly take Bohr's point of view. Now, I've been in correspondence with one of them. They've given me the name of this book by Folsey, the framework of Bohr's views.

**Wilkins:**

Now, this is a new book you're referring to?

**Bohm:**

Yes, and I've been reading the book. It presents it quite well. But the impression I'm beginning to get

is this, which that Bohr's view can be put quite consistently, but you can only discuss with Bohr if you accept his presuppositions. If you don't, you will have nothing to talk about with him. I've been wondering what I can do at the conference. In other words, within these presuppositions you can discuss all sorts of questions about what's better and what's worse, new ideas and what not. So it seems if you have unlimited freedom, an openness, but in fact, it's limited.

**Wilkins:**

I see. And you mean that if you go to the conference and suggest that these presuppositions, which you think the people are conscious of —

**Bohm:**

Well, they may not be fully conscious of them, but they are conscious in part because they've been analyzing the whole thing.

**Wilkins:**

Yes, these things have been [???] but Bohr has sort of defined —

**Bohm:**

Well, his view is basically consistent. There were some points which he didn't work out too well, and these people have tried to supply that in the book.

**Wilkins:**

You mean if Einstein didn't fully appreciate how Bohr's presuppositions were different from his, then presumably they weren't articulated.

**Bohm:**

No. Yes, I don't think that Einstein dismissed Bohr's presuppositions as a tranquilizer philosophy. He wasn't cherishing them. He wasn't going to say, "I'm going to work on them and maybe even improve on them." Nor was Bohr trying to do that with Einstein because he said that was an odd motive philosophy.

**Wilkins:**

So you might find all these Bohr enthusiasts turning their backs on you if you try to undermine their faith

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**Bohm:**

Well, if I were simply to present my own idea they wouldn't quite see the point. On the other hand, maybe we should begin to discuss the presuppositions as the only way out. Just say let's have a mutual discussion of our presuppositions.

**Wilkins:**

Yes, you mean if they're not too dogmatic they might be prepared to bear with you in this type of thing.

**Bohm:**

Yes, let's see if we can work out what our presuppositions are and maybe go beyond them.

**Wilkins:**

You mean it's tactful to suggest that Bohr's presuppositions are not just going to be rejected, but might be developed.

**Bohm:**

Yes, they may be included in a new synthesis, which goes beyond both of us. Right.

**Wilkins:**

Yes, but I think presumably you feel that you'll have to be really rather tactful. Otherwise, you just get their backs up and they won't listen anymore.

**Bohm:**

Yes. But anyway, that shows the importance of dialogue in science, which Schumacher and I really wrote about it as early as 1965 or 1966. In fact, dialogue of that kind is extremely rare in science.

**Wilkins:**

I was just going to say it hardly ever happens.

**Bohm:**

Well, anyway, at that time we regarded it as a problem of communication. Saying communication had failed because we were not — It was a problem with communication, but dialogue looks at it in a slightly different way by saying that the failure is due to presuppositions and assumptions that have not been examined. That perhaps people don't want to examine them because the whole structure they've built, the whole framework, depends on them. If you

build a good solid framework, then you may feel uneasy about examining what it's foundations are.

**Wilkins:**

Yes, you mean if it disappears you'd have nothing left in your life.

**Bohm:**

Yes.

**Wilkins:**

The other thing is it requires quite hard work, doesn't it?

**Bohm:**

Yes, well also it's hard work and disturbing, and apparently not rewarding. It's not going to produce formula and results and Nobel prizes.

**Wilkins:**

A waste of time.

**Bohm:**

Schumaker was a bit strongly interested in the question of language. He felt, as I said, that Krishnamurti's use of language was interfering with his communication. That he felt he would use the language which was, at one point, was too strong in the sense that it tended to make totality statements. Like thought is —

**Wilkins:**

That a man is his conditioning.

**Bohm:**

Yes, man is his conditioning. The thought is the enemy and so on. Then he has to correct it later and by that time it doesn't work. But in general, Schumacher felt there was quite a bit about Krishnamurti's language which was in the way. Which he probably felt was a manifestation of Krishnamurti's deeper character. The fact that he would keep on using this language and not be questioning was somehow connected with what Krishnamurti was.

**Wilkins:**

Yes, that's a very fair point.

**Bohm:**

Yes, and that's the point that Schumacher made very strongly with me. When he tried to bring it up with Krishnamurti, Krishnamurti wouldn't really have any of it. I remember discussion — Donald was trying to say the word is the thing in a certain area because in certain areas the meaning of the word is the essential point. You see, the way you use words will contribute essentially to your emotional state, to anger and fear and so on. Now, when it comes to some object out here, the word is not the thing. Now, Krishnamurti kept on repeating, "The word is not the thing," at that time. Now, Schumacher objected and said the word is the thing. Krishnamurti wouldn't listen. The point is the dialogue broke down there. Both sides were too strong in presenting their position, once again. Although Schumacher was trying to establish dialogue, at one stage the emotional pressure of this takes hold of both sides. If you say the word is not the thing and I say you must be making a mistake, I think the word is the thing,

we are going to get into confrontation and my emotions will be carried away just as yours are and we will both get stuck.

**Wilkins:**

Yes, you really want a more tactful approach.

**Bohm:**

A cooler — you need a cooler approach.

**Wilkins:**

Yes, keep this negative emotions down, where you would say, “Well, now this is a very interesting point.”

**Bohm:**

“Well, let me begin by cherishing your idea. You say the word is not the thing. Let me think about it and think of that in many ways as capably as I can,” right? And vice versa.

**Wilkins:**

Yes, I think one can then go on to examine the whole thing, as you say.

**Bohm:**

It really broke down, and after that they never met. In fact, I don't think either of them wanted to meet each other. Because Krishnamurti felt perhaps that his whole structure was being challenged, and perhaps it was even done with intention to challenge it. But even so, it was not a crime to want to challenge his position.

**Wilkins:**

No, but you mean Krishnamurti had become — well, an anti-guru is a guru. He had become one for his?

**Bohm:**

Yes, but anyway, whatever it was he didn't take kindly to having — See, the point is, even if Krishnamurti could say, "Well, I think it's probably nonsense, but let's at least talk to the fellow. Let's try to — perhaps he needs help or whatever? But let's have a talk about it, right? Therefore, this approach of cherishing the other person's idea is important, to say I will go through a period when I will really listen to your idea tentatively and really

try to go over it in my mind and try to see why you think that way and what attracts you to it, and see if I can even do better than you in presenting it. If they are both doing this then I think something new will happen.

**Wilkins:**

Yes, well there's also the question of listening, isn't there?

**Bohm:**

But that is listening. Listening is active. I mean I think, again, Krishnamurti would say listening with some mysterious thing which just took place. It didn't mean passive, but it took place beyond words. That's true, it does, but at the same time words take their part. It's their dialectic again. Beyond words and words, they are dialectically related. So taking extreme positions you get out of that dialectical flow. So if you say the thought is not the thing and I say it is the thing, we just confront. We're no longer in the dialectical process.



**Wilkins:**

I think most people have extraordinarily strong illusions. It's perfectly obvious. You just listen and you hear things.

**Bohm:**

It takes tremendous attention to listen, and energy.

**Wilkins:**

It's entirely the opposite. It's one of the most difficult things I can do.

**Bohm:**

All your conditioning is against it, you see. Because the minute somebody says something that challenges your framework you are defending, you are not listening.

**Wilkins:**

But don't you also think that there is this great illusion is being built up as some sort of cultural thing, too? That words, the meaning of words — we know what words mean. Stop fussing, stop being awkward, and this is all pedantry and everything.

Isn't that part of the whole culture? It's perfectly obvious what words mean?

**Bohm:**

Yes, but it's clear that words — we were just saying that words have opposite meanings.

**Wilkins:**

Yes, but I mean most people will, I think, dismiss that and say, “Oh well, yes, but still it's all perfectly obvious, and we know what words mean.” But I mean once you start examining it you find that words mean all sorts of things in different context, don't they?

**Bohm:**

Yes.

**Wilkins:**

And as you say the word is the — well, I mean that's —

**Bohm:**

Well, psychologically speaking, the word is the thing to a large extent. The way you use words is

part of what you are. It has an emotional impact. It doesn't just stop there intellectually.

**Wilkins:**

Yes, but I sort of wonder whether — I mean I can quite see the point about people being attached to their own ways of thinking, and how this will alarm them and make them feel profoundly uneasy if they think this is going to be on their mind. But I wonder if this other thing about this illusion about the straight forwardness. Is it some sort of general cultural thing?

**Bohm:**

Well, that's like Einstein and Bohr. They are ostensibly talking about the meaning of quantum mechanics. They're actually talking about the meaning of what science meant to them, right? What truth meant to them. So the words had an implicit meaning, which was not specified, was not made open. So very often in an argument, the real meaning is never stated. People are careful to avoid putting out the real meaning. They hide behind other questions, which only the ostensible meaning. When we find that people can't communicate, what it

means is that there's something else that they're not willing to say because it will disturb them too much to say it.

**Wilkins:**

Yes, you mean what they say is not really what they mean, but is some sort of superficial construction, which is —

**Bohm:**

Well, even an evasion. Even simply an escape from the issue, right?

**Wilkins:**

You know what the GPs say, that generally the patient that comes to see the GP will spend ten or fifteen minutes talking about all sorts of things and the doctor can't really find out why the patient has come. But then the experienced GP knows that as the patient goes and opens the door to leave and go out of the room, then, maybe the thing will come popping out. "By the way, Dr. Such and such," and there you have it.

**Bohm:**

That's true, but you have to ask why does that happen. Because those things are the things that will disturb the patient to talk about, or he's afraid they will. Therefore, those words are the patient. In other words, certain ways of — See, let's take Bohr, who studied using language very carefully in his own way. Bohr's way of using language is Bohr. And Einstein's way is Einstein, right? When Einstein challenged Bohr's ways of language, he was not merely discussing a scientific question. It was not just the assumptions he was challenging. He was challenging Bohr himself.

**Wilkins:**

Bohr's identity.

**Bohm:**

And vice versa, right? So therefore the word is the thing. In the case of [???], the usage of words is the thing we're talking about.

**Wilkins:**

Yes, I think this is a very fair point.

**Bohm:**

And that's what Schumaker wanted to say, and that's what Krishnamurti wouldn't accept.

**Wilkins:**

Yes, presumably the patient going out the door doesn't want to reveal themselves.

**Bohm:**

Well, at that moment he gets his attention on something else and he can somehow manage to let it slide out.

**Wilkins:**

It's a question of being at the precipice. It's the last chance. I won't see the doctor. I'm going away. It's a desperation, I think, at the edge of the precipice. They get the courage to bring it out. I think that this is — I'm not sure whether — somebody was using the word catharsis in this context. I'm not sure whether it's quite right, but the thing is that if you are in an extreme position where you've got some sort of last chance, then I think you can summon up the courage to do something you wouldn't normally

do. So this gets down to how do you set up a dialogue in such a way that people feel that they've got to summon up this —

**Bohm:**

But see, with Einstein and Bohr they never felt that way. Each one was just apparently having a scientific discussion. And so we can have another one tomorrow and so on.

**Wilkins:**

Yes, so maybe if one sat down and thought about it maybe you could do some type of sort of — I can't think of —

**Bohm:**

I think you have to get across the notion of how important this dialogue is and people seriously have to be ready to try it. We could say if Einstein and Bohr had felt that it was more important to dialogue than to defend their positions, or alternatively Krishnamurti and Schumacher.

**Wilkins:**

I don't know whether if you get someone like the science journalists coming in from outside and you ask the person to explain their position they might be more forthcoming because they don't —

**Bohm:**

But they don't know it. The assumptions are concealed from consciousness.

**Wilkins:**

Yes, but if you have an intelligent science journalist, they might sort of probe at them.

**Bohm:**

Yes, but imagine trying to interview Bohr. You would have to be as subtle as Bohr. Bohr was very firm if you talked with him. Either he would light his pipe and let the matches drop. Or else he would come out very firmly with very great power. Who was the journalist to challenge Bohr?



**Wilkins:**

I suppose you mean he was such a remarkable person it was very difficult for anybody to get into a chink of his armor.

**Bohm:**

No, no. As long as you stayed in his framework he was very open and he had very wonderful discussions.

**Wilkins:**

Yes, well, this is the thing about all scientists. That they're very open minded within limits, but they decide the limits.

**Bohm:**

They don't even decide it. It's the unconscious process.

**Wilkins:**

Yes, they just decide it for themselves.

**Bohm:**

You know when they get the limits because they get all edgy and bad tempered. And, as you say, they drop their pipes on the floor. So therefore, see here's this point. Schumaker was particularly pointing out the importance of dialogue and the word is the thing and all that. And here was Krishnamurti saying the opposite, and there was a confrontation, which was fruitless and really destructive. I think that we have got to go into this theory of dialogue a bit and say that people appreciate the theory of dialogue; they may be able to approach this thing in a different way.

**Wilkins:**

Okay, but in practice, what type of practical means? If you examine the Einstein/Bohr situation, what could you have done?

**Bohm:**

Well, I don't know. I think that the first thing would have been to discuss with both the sole question of dialogue and try to make it clear to them and see if they would really appreciate the importance of it.

**Wilkins:**

What would happen if you came to each of the parties separately and said, “Look, these damn arguments have gone on along now for years.” You could say both of you are being sort of ridiculous.

**Bohm:**

But we’d talk around it. Dialogue with other people. Dialogue here, dialogue there, how important it is in this area, that area, how it works.

**Wilkins:**

Well, that’s one approach. I was thinking the other thing is you’d try and just bring them up in a joke and say, “Look, you people have been messing around for years like this. I mean you’ve got to do something.” Pull your socks up, for God’s sake.

**Bohm:**

You’ve got to combine it with a general theoretical approach, which suggests there’s something that can be done.

**Wilkins:**

Well, yes, I agree that may be the more suitable means with that type of situation, because you can't very well talk to distinguished figures like that.

**Bohm:**

No, particularly if you don't have some structure, some sort of suggestion as to what could be done.

**Wilkins:**

So you would get them to listen to an exposition of the theory of dialogue and get them interested.

**Bohm:**

Yes, even write a paper about it and have them read it.

**Wilkins:**

All right, well, better write a paper on dialogue then. What are you doing about it?

**Bohm:**

Well, tomorrow I'm talking over with this Peter Garret. We're going to try to prepare a paper. You

don't know him. He's from Nicholton. He wants to come to this group Demarito to look at it. But anyway, that's sort of a tentative answer seeing I don't know the full answer. But that's sort of a beginning.

**Wilkins:**

To get at the ideas, the theory articulated.

**Bohm:**

But that's sort of the importance of the theory. And therefore, if we go back to Hegel — see, let's look at it a Hegelian way and say, “Look, I am presented with this situation that's just simply the real situation going like this confrontation, right? And then on the one hand I can try to be like the practical man and try to say my end is to get rid of this confrontation, so I'm going to find some means and work on it and change it. But it doesn't work because that's much too crude a way. So then I say, “Let's look at it as the scientist, saying here I'm presented with all this and I'm going to let it reveal itself”. And then I form a theory of it. But in this theory I appreciate the essence of it because there it's clearly a problem of thought, the theory is thought. And therefore I'm

able to appreciate the essence of it to a certain extent. Rather it's not merely — it works in me and then everywhere. I'm not separating subject and object, you see. So the point is then part of this is to say that opposites must be present and must be united, and this is part of the dialogue to come to a new unit offkeyhobin, a unity of opposites, which transcends those opposites. Saying that perhaps Einstein and Bohr could have transcended their position and gone into something really new. Or Schumacher and Krishnamurti. In fact, that's what Schumacher had in mind that Krishnamurti's position would be transcended. But I'm afraid that Schumacher did not have in mind that Schumacher's position might be transcended.

**Wilkins:**

Did you ask him?

**Bohm:**

No, because I thought he was rather disturbed by the whole thing. I don't think I was able to hold a really good conversation with him about it after that.

**Wilkins:**

Of course, Krishnamurti may have been conscious of that, too. It may have not helped. Because presumably there has to be sort of an agreed recognition of what he's going to say each other's vulnerability.

**Bohm:**

I think Schumacher had the idea that it would be a new — he called it a form. That this new thing would be a new form, a new formative activity, and that it would be his. That's my feeling and that was not right.

**Wilkins:**

Feeling a bit personal about it.

**Bohm:**

Yes. The point is the new form may not belong to anybody.

**Wilkins:**

Yes, well, this is of course an interesting point about an almost DNA history of the same thing about the

people who did things and what it belongs to. I think obviously. I mean, the individual can regard themselves as sort of channels through which the new truth emerges or something.

**Bohm:**

But in the dialogue it doesn't emerge through either individual.

**Wilkins:**

Okay, well, the form a joint —

**Bohm:**

Something new appears in it. There are several, if there are more it's a bigger channel. But between — in the dialogue, if something new emerges, which is not either of those extremes. So let's say as Krishnamurti says thought is not the thing and Schumacher says thought is the thing, but something may emerge which is neither of those.

**Wilkins:**

Yes, well, I still don't see how you can get them interested in the idea of dialogue, and what you can hope is that their interest in this idea may help them



to not get overwhelmed by their feelings of falsified entity —

**Bohm:**

Yes, and being attached to their frameworks and so on.

**Wilkins:**

Yes, if you can get enough positive feeling there. I think the point is yes, presumably, someone would say a perfect situation would be someone they would get so excited with the idea, the wonderful prospects of dialogue, they would quite sort of forget about their attachments to the — I mean that's the positive view, isn't it?

**Bohm:**

Yes.

**Wilkins:**

You want to get an ongoing enthusiasm, which will carry them through. I was interested to see this word enthusiasm means in a sense the God within. So in a sense you're letting not the cat out of the bag, but

you're letting the God out of yourself. This is exciting.

**Bohm:**

If the two Gods come together, then you have something newer.

**Wilkins:**

Yes, you mean it's like the alchemical flask where you have the union of these things and the new child emerging. Yes, and of course the chemical model is true in so far as the original two components tend to disappear.

**Bohm:**

Anyway, but the other point that Schumaker — he was very interested in this question of language. He studied Wittgenstein a great deal. But I must confess I never understood Wittgenstein very well. So?

**Wilkins:**

Oh, he found Wittgenstein interesting?

**Bohm:**

Yes. I think in the end he feels that Wittgenstein had gone astray, but he found it very interesting. But I can't comment much on that because I could never get a strong grasp of Wittgenstein. I tried to talk with him about it.

**Wilkins:**

Tried to talk with Schumacher about it?

**Bohm:**

Yes, I mean we did talk about it, but it somehow didn't leave a deep impression.

**Wilkins:**

I was in Cambridge as an undergraduate when Wittgenstein was digging potatoes outside, and I knew one undergraduate, who was, I would say, infatuated with Wittgenstein. I think he — being in a little circle, his main idea was that he was going to get a job in the patent office when he got his degree because that's what Einstein had done. That was sort of naïve.

**Bohm:**

He should have listened to Einstein, who said never tell the same joke twice.

**Wilkins:**

Of course, there were very good practical reasons for that, weren't there?

**Bohm:**

At that time, yes. Now days it wouldn't work now.

**Wilkins:**

Yes, normally you're right. I think that getting people enthusiastic about dialogue will help them over their hurdles. Of course, the Quakers talk about listening a lot. It's one of their —

**Bohm:**

It's not really listening, but it's being more active this style in the sense, you know.

**Wilkins:**

Yes, you mean a dialogue is not simply listening. You mean it's the — you say something yourself.

**Bohm:**

And also, you respond and you may take up what the other person says and carry it further and so on.

**Wilkins:**

Apparently some of these principles are recognized fairly widely in jobs like counseling. You see patches done at [??] in bereavement, and she says there the main thing they're emphasizing to the counselor is this thing about this thing and how extraordinarily difficult listening is because you're always starting to impose your own interpretation. How you may say something yourself from time to time, it may not be that you say anything. You may simply make a sound or a grunt, and also the way in which you move your body may be important. All these things. You create a whole environment there, which is somehow reacting sympathetically to the person.

**Bohm:**

The point is to create an environment of openness.

**Wilkins:**

So you came to encourage this stuff.

**Bohm:**

Yes, but I say if you can respond to the other person in the right way it may encourage them still more, if you don't impose your view, but you respond positively.

**Wilkins:**

I think this is where — there was a very interesting television program on babies that die at birth. When Pat said this was coming on I thought, “Oh, God, dead babies. Stillborn babies.” I’m going in my study. I started listening, watching it, and this is very interesting because there you have to — one has all sorts of prejudices initially, and I was rather horrified about this. That how important it is that the other people can provide some sense to the — apparently it’s an extremely distressing phenomenon, this burying a dead baby. Of course, what I never thought through before is that if they tell you the baby’s dead before you deliver the baby

then you have all this awful job of the mother pushing this baby out, knowing it's bloody dead.

**Bohm:**

It's all for nothing.

**Wilkins:**

This must be an extremely depressing experience. And although they've never known the baby at all, apparently they have a very strong sense of the identity of that baby that has been inside them for nine months. I never thought or appreciated all this. And the counselors were coming on and saying how everyone avoids them. This has been let down the neighborhood in society. It's that dead baby. It's horrible, isn't it? We feel very sorry for them, but we don't want to talk with them. They were stressing how you want to draw this out. And I think to some extent, this whole thing is very similar. Except I suppose in your case with Einstein and Bohr — well, did they have a dead baby inside? Presumably, something was worrying them, wasn't it? They were meeting. They wouldn't have come together.

**Bohm:**

There was a problem of how to understand.

**Wilkins:**

So they both had a problem.

**Bohm:**

Bohr felt he had solved it, and Einstein felt he hadn't.

**Wilkins:**

If he thought he had already one hundred percent he'd solved it, why would he waste any time talking to Einstein?

**Bohm:**

He may feel just because he's a friend of Einstein he wants to communicate.

**Wilkins:**

Ah, you mean he just wanted to try and convince Einstein that he'd got a perfect solution?



**Bohm:**

Yes, saying disabuse him of his wrong notion, saying Einstein had sort of going back into this old past pattern sort of. Maybe it will liberate Einstein's creativity to get out of it. Any number of things —

**Wilkins:**

So really, Bohr didn't see it. He didn't have a problem. Einstein —

**Bohm:**

Einstein had the problem. Yes, Bohr's problem was Einstein.

**Wilkins:**

Einstein then felt that Bohr had a problem.

**Bohm:**

Yes, Einstein's problem was he couldn't accept the way Bohr was going about it. He felt it was wrong. He had a basically different idea of how to go about it.

**Wilkins:**

So they really both had dead babies inside them, and they didn't want to face up to the fact. Gosh, it's not easy. I mean I think you know if you do — I think Pat may have a video of one of those things. If you see some of these people going through practical situations where it is difficult for a person to listen, and listening as you say involves a very active exchange with the person, which may involve saying something or may not.

**Bohm:**

Yes, it may be the body.

**Wilkins:**

Actually, one of the counselors was always saying how important it is you say you're sorry. I think, actually, Pat agreed with me that she didn't mean that. Because simply saying you're sorry doesn't necessarily get you anywhere at all. But I think what they were trying to say was is that you somehow have to express an appreciation that the other person has a problem. But as you say, in this case —

**Bohm:**

Well, neither of them would appreciate the problem with the other, because they were basically — each one felt the need to defend his own position or his own framework.

**Wilkins:**

I still feel that if the idea, as you say, of interest and enthusiasm for the idea of — sometimes you need to say that I know that Einstein has got this all wrong, but this would be an intriguing game to play, which I know isn't really serious, but I will play it nonetheless, kind of thing. I mean sometimes devices like this can help, can't they? To get the ball rolling.

**Bohm:**

Yes. But Einstein would also have to play the game with Bohr. In our paper we actually started that, whether Bohr would start playing Einstein's game. Because we thought Bohr would probably have the subtlety to do it.

**Wilkins:**

In your paper you were saying that?

**Bohm:**

Then perhaps Einstein would eventually start the other side. But I think we proposed that Bohr could have started playing Einstein's game a little bit.

**Wilkins:**

Yes. In the studies on attitude change, the psychologists have found that if people have two strongly opposed attitudes and then if the person has to play the role of the person with the opposed attitude, they find it does make quite a difference to the attitude, having been through that experience. Of course it's quite reasonable. So this is a standard procedure in trying to understand people's [???

**Bohm:**

That's part of what constitutes cherishing the other idea.

**Wilkins:**

Yes, if you're playing a role you have to cherish it, because the role is yourself for the time being. The role takes you over. Yes, but that isn't dialogue that's normally understood is it?

**Bohm:**

No, but I'm trying to say it's the kind of dialogue that's needed.

**Wilkins:**

Yes, I think that's a very good point, because I think that this is a fairly clearly defined and easily understood type of operation, which could be very helpful, which is not normally — I think most people tend to have a sort of idea of dialogue as being sort of as two chaps sitting down have a nice sort of long conversation over a cup of tea, an exchange of views or something. But when you introduce an idea, a kind of role-playing idea like that, you are going much outside the ordinary bounds of conversation.

**Bohm:**

Yes, but we've got to do something radical like that or else we'll never get through this. That's the other possibility is possibly in the larger group, some sort of energy might arise that would break through. See, when two people are there, there is always the tendency to confront. We've got to get something powerful enough to get through that.

**Wilkins:**

Yes, well I don't know —

**Bohm:**

Once you start confronting you're stuck.

**Wilkins:**

Yes, this sort of negative thing, which makes it more difficult because you start — you don't want to concede points, all that.

**Bohm:**

Well, I'll say you'll become defensive. The more one person says something the more you become

defensive. If you're playing the role of the other person, then you're no longer defensive.

**Wilkins:**

Yes, I think the subtle thing about it is in playing the role; you kind of kid the person that it's not serious, and that's why they're prepared to do it. But really, as you say, it is very serious indeed and the person is fooled. I don't think — it's not dishonest.

**Bohm:**

No, well he may — probably deep down people know the game is being played, but they sort of enter the spirit of the game.

**Wilkins:**

Yes, I think that's it. That you're ready to have a go. Well, it seems to me a very good idea. What other ideas did you have in the —

**Bohm:**

Well, there was no other idea. The only idea we had in the paper was we thought it was appropriate that Bohr might have started it. More plausible than if Einstein would have started it.

**Wilkins:**

I suppose you could think of other forms where you had an audience or something, but these would still be the same. Not essentially. They're different if you had to explain to an audience, if Bohr had to explain to an audience what Einstein's theory was. With Einstein out in the room possibly. Or not at all with Einstein in the room. I don't know. You could do it different ways, couldn't you?

**Bohm:**

Yes, well, that would be the same as if Bohr would write a paper on Einstein's?

**Wilkins:**

Yes, you could write a paper, go through the same exercise. That may even be better because you have to — Ah, yes, the whole thing — there is the other thing about attitude change. That if you make a commitment in front of other people that apparently if a speaker is trying to persuade the members of an audience to adopt, to support their point of view, the speaker's point of view, that if you get somebody to come up who feels they would like to support it, to



come up to the front of the room and address the audience and make a statement supporting the point of view, then this apparently strengthens their degree of support considerably because they have made a commitment in front of other people.

**Bohm:**

Yes, it carries more weight and it's more important.

**Wilkins:**

Yes. I think then they feel that they mustn't back down from that. That if they are seen by everyone else to be holding this point of view or representing this point of view, they have a certain pride in the whole thing. It's part of their identity then. And so that this thing about standing up and — is it witness?

**Bohm:**

Witnessing, yes.

**Wilkins:**

Is very important. I don't know whether this type of thing could be — that's where I think you have other people involved. Other than the two people in

dialogue. But there may be other principles. I don't know.

**Bohm:**

Well, that requires exploration to treat dialogue as an object of study and to try to make a theory of it, which will then make it possible to change the whole thing, just as we do with other things. But anyway —

**Wilkins:**

So incidentally, that negotiation book. I don't know whether they're — I don't know. There might be a few points there a bit. I forget what I was saying about being hard on the people and soft on the problem or something. They had various slogans, which were —

**Bohm:**

It's a very static point of view because the subject is sort of given, so is the object. You don't consider it the subject and object in their movement intrinsically, but rather movement as being imposed from the subject to the object, or a subject on itself. Now, so I thought maybe we could get a language or

usage of language that would avoid this problem. Now, I thought maybe if we took the verb as the basic element rather than the noun we could get out of this, because we would begin with process and flow rather than sort of beginning with objects and then somehow discussing process. Because it's a sort of contradiction if you once begin with an object and there's no real clear way of getting to a process except as the object acting on another one. That doesn't really see the constitution of the object as a process. Now, that is a thought of the process being the flowing stream image of a vortex, which exists only in the flow as a recurrent pattern with stability. So I had this image, remember, in all of my previous work of trying to explain things as relatively stable and recurrent patterns in a universal flow or flux. I said objects should not be presupposed first and then actions between objects, but rather the movement is primary, and objects arise in the movement. And then there is a secondary result the objects will be acting on each other as two vortices brought together modify each other. Fundamentally it's the whole flow.

## **Wilkins:**

Yes, but you mean that the objects correspond to these regions of stability.

## **Bohm:**

Stability and recurrence, right? The vortex does not actually exist. It's an abstraction. There's no such thing as a vortex. There is an abstraction of a stable recurring pattern of flow. But when you take the word vortex it means in your mind you extract that and think of it as an independent thing. Using the ordinary language, you're almost forced into that. Then we could say one vortex pushed on another one. But then in fact that didn't happen. Just simply that two patterns of flow modified each other. They combined and fused into one, which was different. Is that clear then what I mean? See, if you put two vortices — one vortex's pattern extends to infinity. In other words, you bring two vortices together; at first they have very little effect on each other. But you can see that on the plane between them the velocity is zero on that plane. The patterns have been modified.

**Wilkins:**

Yes, but a vortex has its main concentration — I mean if you consider a smoke ring. I mean the smoke, that particular region of air, is kept intact to a large degree, isn't it?

**Bohm:**

Yes, but still if you bring two smoke rings together that smoke ring has a pattern of flow extending out.

**Wilkins:**

Yes, so it is dispersing gradually.

**Bohm:**

But even if there were no friction it wouldn't disperse. It would be stable. But it would still have a pattern of movement extending beyond the center of the vortex. There's no sudden end to the vortex. So the pattern extends out to infinity in principle. Now, another vortex comes along from far away. At first they don't affect each other very much. But if you take the plane between them you will find that the velocity perpendicular to that plane is zero. The two combine. When they're far apart it doesn't have very

much affect at the vortices, but as you bring them together there's a kind of a force develops between them, and eventually the two vortices modify each other profoundly and unite into one. But in no stage are there really two vortices. Each vortex is an abstraction from one single pattern of flow.

**Wilkins:**

Yes, you mean you're concentrating attention on a particular region, of a pattern, not on the whole.

**Bohm:**

Yes. The ordinary usage of language would say we have here a vortex and there a vortex and they're interacting and one is acting on the other. But that doesn't really give a right picture of what is going on, because the whole thing is one flow and even the very constitution of your elements arises in that flow. Whereas the ordinary language suggests that the movement has nothing to do with constitution of the elements that are acting and being acted on.

**Wilkins:**

So that the language corresponds to a partial view of the —

**Bohm:**

An abstract.

**Wilkins:**

Yes, a sort of simplified partial view of the whole thing.

**Bohm:**

Yes, the word abstract is what's called for. It means to take out a sub part and consider it in your mind as if it were separate when it's not. We've got that.

Now the point was can we change the language.

Now, it turns out that some of the older languages — see, I suggested let's begin with the verb as the basic element and build nouns and so on out of verbs. This might be more appropriate, right?

**Wilkins:**

Can you give an example?

**Bohm:**

Well, in older languages this is what's done. It's even done in English, too, as I'll explain. But in Hebrew, the basic root is always a verb, and by

adding prefixes and suffixes you can turn it into adjectives and nouns and so on. The verb to work can be taken — the verb work may mean — the verb may then stand for the action of working, you see, for a worker, right? But even in English you take a verb alternate, and the noun is alternation, a state of alternating. We have the possibility of turning verbs into nouns, but it is not the most basic structure. So, saying could we change the language so as to put the verb at the base, as it was in Hebrew and apparently in many other primitive languages like Tiomno and so on. It seems common that movement was taken as basic in earlier languages. Only later came the development in which we put the nouns as basic as in the modern Endo-European language. But of course by now Hebrew is used in the same sense as Endo-European languages that though the verb is the basic root people are treating it — they use it as a noun anyway. So it's a matter of how it's used, not merely the formal structure that counts.

**Wilkins:**

Well, what did you do at this stage?



## **Bohm:**

What I proposed was to — I said we can't change the whole language like that because we're, as Bohr used to say, "We're immersed in language." But rather I said, "Let's introduce a different mode of using language." Like we have the indicative mode and we have the subjunctive mode and the various other modes, imperative. So we introduced what I called a real mode, real from the Greek word flow. The flowing mode. Saying that for certain purposes we would use this mode while at the same time we are not going to try all at once to change the whole language. So the attitude is to say this was to be an experiment with language. Now, people ordinarily study language as an object, saying, "We're not experimenting with it; it's an object which is there and we are making a theory of it, right?" But I'm trying to say language is modified in the very way in which it's used, so there's no such thing as a fixed language in which you can study. You can do it approximately, but the very way people use language, it constitutes language. And if you begin to use it differently, language changes. I was sort of opposing the view of Chomsky say that language is some sort of inherent universal grammar. There may

be such a thing, but to say language is limited to the sort of thing that we study as an object, I don't accept. I say language has infinite possibilities, and as we start to use it differently it's different. So to experiment with language is to discover the possibilities of language rather than to say take language as it has been used and study it. Now, what I proposed was this new mode, and at that time people were using the word relevant a lot so I thought it would be nice to bring it in. So it comes from a verb to relevate, now out of usage, meaning to lift up. Now elevate. It has two possible meanings. One is relief, to bring relief to lift off the problem. The other meaning is to make it stand out in relief. Lift it out of the context, right? So I took that meaning. So I said to relevate would mean — I said let's bring back the word relevate, to lift it out of the back ground into attention, make it stand out as if in relief. But the word re, what is it doing there? The basic word is levate. So I said to levate means to give attention to this process of lifting out altogether. In all possible context.

**Wilkins:**

But you say relevelate.

**Bohm:**

But to relevelate means to do it again. Therefore, the first act is levelate. Then the next act is relevelate. If you relevelate you can ask — we'll introduce an adjective, relevant. Is it relevant? Is it appropriate to relevelate it? See, if many things once it can be leveled up to a point, but after that they no longer count or they no longer have bearing, right? So therefore we could say it's either relevant or irrelevant. Is that clear? It doesn't bear — it's no longer appropriate to lift it out because it has no bearing in the subject anymore, right?

**Wilkins:**

Sorry, what are those two things?

**Bohm:**

Relevant. Re with — instead of saying relevant if put re-levelant. Do it that way to emphasize the different meaning.

**Wilkins:**

What was the other one?

**Bohm:**

Irrelevant.

**Wilkins:**

Yes, I see.

**Bohm:**

So you're saying that to a point it's relevant beyond that it's irrelevant. I said that would be crucial for everything, right? Therefore, the word levate means to lift into attention, the whole act of levation without restriction. I said let's use that as a basis and generalize the language in saying — we could do this much more generally, you see. Let me see if I can remember all the different words I used. One word you might introduce is to see. I use the Latin word videry there, as in video. So I said let's introduce to vidade, which is to bring into attention all acts of perception. To revidate is to see again, in a certain context. That may be revident or irrevident. Is that clear?

**Wilkins:**

Yes, roughly.

**Bohm:**

You could go on from there to where I can't remember. You can use words in that way. You can construct words in that way a long way.

**Wilkins:**

What use did you actually make of this?

**Bohm:**

Well, the point is that this was a way of — See, you have to use it a bit to show. For example, I introduced the word to factate. Facar means to make in Latin. Factate would be to bring to attention all acts of making, which might be refactant. To refactate might be refacted or irrifactant. The fact might either be a fact or not a fact. And then the fact had to be constated. See, the word constant comes from constate, meaning to make it stand together; a stand. So a fact has to be established by constating it. But actually you would say to reconstate it because it must be again and again. It might be

reconstant or irreconstant, and so on. I went through a whole long list of words. The point about this is to show that we can construct these words to be able to look at philosophical questions. When we do this, you can see we are not thinking of the object primarily. See, this is the first point. Suppose I take the word — we also don't separate subject and object. If I take the verb to levate, it means to call everything into attention all acts of levation. At that very moment you are levating a content. You are doing what you say you are talking about. Ordinarily, there's a distinction between what you're talking about and what you're actually doing while you talk, which separates subject and object. The subject is the one who is talking and thinking and the object is what he's talking about. But the subject is the very same as the object here.

**Wilkins:**

Yes, well, that applies in that particular case.

**Bohm:**

It will apply in every usage of this word.

**Wilkins:**

Yes, that word.

**Bohm:**

Not of this word, but of this kind of word.

**Wilkins:**

That kind of word. I see.

**Bohm:**

If you vidate then you are seeing something. If you factate you're establishing a fact. You can go through the whole thing. In each case when you use it, it happens. So you can establish that you are not separating subject and object. You are not establishing a fixed thing because you say there may be a state of levation or relevation, which is constant. Or a state of vitation. So we introduced the verb revidation, which is a constant state, which is the first noun. So we have introduced adjectives and nouns out of the verb, as the older languages did. In this way I suggested you could deal with philosophical problems differently if you would, but everybody would have to begin talking. And so I

said unless we seriously get together you can't get too far about this. But it's an experiment which shows that language can change. For example, one of the difficult problems was how do we deal with the self, which is a very strongly noun or pronoun. So suppose I introduce the verb I am in the basic sense of self. If you go back to the Bible to the story of Moses, he talked to the voice in the burning bush. So he asked the voice, "What is your name?" And the voice answered, "My name is I am." In other words, God's name was I AM, because only God could say that. And I am would have been a hen [?] in Hebrew. He first asked what is your name, and he said, "My name is I am that I am," or, "I am whatever I am." Only God could be that. Then he asked him what shall I say your name is to the tribe of visitors? He said, "You should say my name is I am." The idea is that in Hebrew there is no present tense of I am. The verb to be has no present tense because you don't use it. You say this chair right here. You say this is a chair. Is that clear?



**Wilkins:**

I see.

**Bohm:**

Now, you can only say I will be. In order for God to say what we mean by am, you have to say I will be whatever I will be. But in principle there is no I am in Hebrew. The fact that there was no present tense of the verb to be meant that this usage of the word I am would have a very powerful meaning. That I am meant pure being from the subject aside. It really was the natural name of God. The notion was only God could say I am, or to put it in Hebrew that I will be. Only God could say that. I will be because that meant I will be forever. In that sense that would have been the natural name of God. So the question is how you put that in the sense of flow? You can't if you have this absolutely eternal I am, you can't. The point is that human beings have identified their personal I am with this eternal I am by the very use of the words, right? And that's part of what's behind egotism. Because in the very structure of thought and language, I am, once we got to it, meant the eternal I am. But then each person, by calling

himself I, or saying I am here instead of I am is conveying to himself that meaning. Do you see what I'm driving at?

**Wilkins:**

Yes. It is seeing God in yourself in a rather peculiar way.

**Bohm:**

It has a very powerful psychological effect. That language has a powerful psychological effect, and to say in the psychological situation the word is the thing. You can't separate them.

**Wilkins:**

Yes, that's very true.

**Bohm:**

Now, the words for I am are the most powerful words there are, you see. So how would you deal with this in the real mode? This would have to say that the human personal self is not I am. But I introduced a verb to start from an action. I introduced the verb to iamate, which would mean to bring to attention this whole process of I am. We

could say that when a person says I am in some sense he iamating, or he is really reiamating. The original iamation would have been a creative step, but in the habit of reiamating has become irre-iamant. He keeps this up and it no longer has any meaning. So the idea was that we would have to bring our language into process all those things, which are really absolutely eternal nouns now. That would change the psychological impact.

**Wilkins:**

Well, I can see that you are demonstrating that you can develop a new aspect of language like that, but having made this demonstration did you actually use this?

**Bohm:**

See, you can't use it by yourself. The language must be communicated. It can only exist in communication. I gave two talks on this to the Institute for Contemporary Arts and there was a lot of interest, but I didn't pursue it. One trouble was that suppose we set up a group to talk this way, then we would have sort of begun to isolate ourselves with our particular language.

**Wilkins:**

But can't you do it on your own?

**Bohm:**

You can't talk on your own, no.

**Wilkins:**

But if you write a paper you are, in a sense, talking to yourself.

**Bohm:**

Yes, but at a certain stage it becomes empty to keep on using language just to talk about language. If you talk about something else nobody else will understand it.

**Wilkins:**

Yes, but you will. I mean the thing is if you had a certain problem to study and you then started dealing with this developing a solution to the problem using that language, you would then be gradually setting out your ideas, which would develop —

**Bohm:**

But you see, language could have never developed that way, saying I've got a problem and I'm going to learn the language. It developed as people communicated.

**Wilkins:**

Yes, that's quite true. I mean, what you're saying is that the language enabled people to communicate more effectively, one with another.

**Bohm:**

About certain deeper questions.

**Wilkins:**

Yes, all right.

**Bohm:**

It wouldn't at the same time forbid them to communicate in the old way when that was appropriate.

**Wilkins:**

But I think what I was suggesting was that if you use that language to study some deeper question yourself, that when you start writing your paper, you wouldn't have all your ideas here in your mind. They would develop. You would in fact be talking to yourself as you develop the ideas. So this might help you to solve the problem.

**Bohm:**

I don't have a problem.

**Wilkins:**

Well, there are lots of problems [???] You say you don't have a problem.

**Bohm:**

Not of that kind. It is not a problem in the sense that you consider it to be. See, the practical reason has problems. It says this thing is this way and I must have — through certain means I would achieve a certain end.

**Wilkins:**

You mean the language, you say, would help people to communicate?

**Bohm:**

But if they don't communicate it's not doing anything. See, fundamentally, dialogue, for example, is not a problem.

**Wilkins:**

Okay. But can't you have dialogue with yourself?

**Bohm:**

Very limited, because —

**Wilkins:**

I think you might if you write things down.

**Bohm:**

But you see, in the case of developing a different language it's very limited what you can do. I did try to write some things down, but you eventually get to the point of just talking about it.

**Wilkins:**

Well, I can see this might be —

**Bohm:**

This was something that Schumacher was very strong about it. He got a bit annoyed talking about talk and so on. I mean there's a very limited value to that.

**Wilkins:**

Talking about talk?

**Bohm:**

Talking about language. To talk about language is limited. You can talk a certain amount about it, but then eventually you've got to talk about something else using that language, right?

**Wilkins:**

I think you could have a dialogue with yourself by setting ideas down, because the thing is that different ideas come into your mind at different times, and you could set something up like that.



**Bohm:**

I think you really needed some people to talk at. See, I changed the word from reamode to reamodation to say it isn't a noun, it's a process. There is no such thing as the reamode. There is the process of reamodation. Now, you have to engage in this process. The ability to have a dialogue with yourself is rather limited.

**Wilkins:**

I've sometimes found that if I've been thinking about something, I will write down a question. And then having written the question down on a piece of paper it's, in a sense, a little bit like somebody having made the point. Doubtless this happens to everybody, presumably, but it is very difficult to think out anything, develop ideas, simply in one's head where you have to have memory to sort of remember one thought and it leads on to another one. This is why you write things down. Isn't this where you were?

**Bohm:**

Well, yes, but you'll find it is much harder to do this with changing —

**Wilkins:**

Yes, I can see that.

**Bohm:**

The point is if you're going to change the language, the meanings arise in communication. Simply writing something down is not going to get very far. [Pause to make a phone call]. I think this language; there is something in communication which is essential. I actually talked a bit with Schumacher in these terms; we did a little bit that way. But because of all these things that happened, we never got on with it. So I published it in the book, *The Wholeness and the Implicate Order* as a chapter just to show what might be done with it so that one could see that our language is really holding us back and we are affected by our way of using it. Now, the next chapter sort of followed on that, which was saying that this language was aimed at a natural way of dealing with process, which would not only be a

process, but which would be conscious of itself as a process. That the language would draw attention to itself as a process in realmodation. So where as an ordinary language it does not draw attention to itself as a process, but as something which is sort of aesthetic. We are not conscious when we ordinarily use language that we are engaging in a process. Our consciousness is not — we are not conscious of the process, but in realmodation we can be into the conscious of the process because the very word realmodations suggests that's what we're doing. I had words for language as well I can't remember, which would be more or less like bringing in the word to languageate. I had a better word than that. What is the Latin word for talk? I've forgotten now.

**Wilkins:**

Diere [?] or something.

**Bohm:**

Maybe. I can't remember now. But I had some sort of — I usually went back to the Latin root and constructed a word. For example, to think, I use the French word *pensar*, the Latin root, *pensamento*, Portuguese. So I said to *pensate* would be to get

attention to thinking. To repensate would be to continue that, which could be repensant or irrepensant, but one would have to go through this whole pensation, would be thought. Or really, repensation. So the first point was to go through some words to see how you would use them in the short context. To make a really long context I think would require some real attempt to communicate that way. What I did lead on to was the question of understanding the nature of process, because we were saying that the basic idea was what is is movement. What is is process. That's the ancient idea of Heraclitus, right? But then we have a contradiction in our ordinary way of talking because we say our language is not treated as a process. And in fact, if I say what is is process, I don't treat that statement as a process. I say that's going to be the truth, right? But suppose I say what is is process, what is is movement, but even that isn't movement, so that leads to dialectics. Is that clear? Whatever statement I say, it is going to move to something else. Is that clear? If you apply the notion of movement to thought itself you will inevitably come to dialectic. If you don't come to dialectic you're saying other things may move, but thought is not

movement, except in a superficial way. You may say thought moves, but thought is movement means dialectic. If we say what is is movement, then thought must be movement, then what thought is must be movement, therefore, it's the movement which is thought and not the static concepts.

**Wilkins:**

Yes, when you say dialectic, that doesn't necessarily include the idea that you have the opposites.

**Bohm:**

See, the minute it moves it moves to something different, right?

**Wilkins:**

Yes, this is the point about whether differences are

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**Bohm:**

Carried to extremes, that must lead to the opposite, right?

## **Wilkins:**

There was something which I meant to read about this about the point to what extent differences can be represented in an opposition and they're not all together [???

## **Bohm:**

Well, the essential differences are oppositions. That's the idea. There are differences which are mere variety. But for example, in movement on a line we have the movement one way and the movement the other way, right? So we find that the essential differences in movement are in opposition. The point now of going further with that was that how are we to understand this process if what is movement, but we are going to seem to be denying that by saying even this much change to its opposite? Or to something else, anyway. And therefore it seems we can't maintain this view. So that was a puzzle. So I'm trying to say that came from the use of the Aristotelian logic. Because if we say, according to Aristotelian logic, we could say A is A. We could say A is not-A. That's one of the basic assumptions of Aristotelian logic. And

between A and not-A is no mean and so on. Suppose we now say we have thought and non-thought, the basic division. We say there's a kind of reality beyond thought and there's thought. Using Aristotle's logic we would call thought T and a non-thought NT. We would say T is not NT, right? That's the first statement. But we could immediately see that this can't be true, because thought has a being, which is beyond thought. For example, movement in the nervous system and so on. Therefore, thought is non-thought. Is that clear?

**Wilkins:**

I think so.

**Bohm:**

At the same time, we would also have to say non-thought is thought because whatever is non-thought is grasped in thought. The very notion non-thought is a thought. So thought is non-thought and non-thought is thought. So we have the contradiction and the attempt to separate the thought and non-thought. And also, what we can then say — So therefore Aristotle's statement something is either thought or non-thought can't hold, right? So we have to say it's

both. First of all, something is both thought and non-thought, which is a contradiction. And then in the end you say it's neither thought or non-thought because it's something beyond both. What's implied by that is a higher synthesis beyond both of those. So we have to say some reality is implied beyond the distinction of thought and non-thought, because thought is part of reality, and reality is part of thought. It's a word which is part of thought. So therefore, you have to give up this Aristotelian logic to discuss this question.

**Wilkins:**

Yes, I think that's the important point to try and get clear.

**Bohm:**

The question is what will you do then? What can we say about thought that get that puzzle by? What I wanted to propose is to say that we can understand this. When we get this far we're asking the question what is the meaning of metaphysics or assumptions about the nature of reality, which is where we're coming to? This metaphysics is true even if a very small child was doing it. The minute he makes a



distinction of thought and non-thought, he is doing metaphysics. That's reality and that's only a thought. Now, because that distinction is proposed in thought, you say that applies to everything, everything is either thought or non-thought. That's the way we get these oppositions. We make a distinction which applies to everything. You say everything is either thought or non-thought. They must stand in opposition.

**Wilkins:**

Yes, do you mean a child has a consciousness that he can distinguish something in the imagination from the real?

**Bohm:**

From the real thing.

**Wilkins:**

But that process of distinguishing is thought.

**Bohm:**

Not only that, but once he goes further and says everything is either something real or in the imagination, then he has gone into metaphysics.

**Wilkins:**

That's true.

**Bohm:**

Every child is full of metaphysics. It's not just philosophers.

**Wilkins:**

Yes, well, what about magic? You mean that he can add that or not add it?

**Bohm:**

Yes, well, that's another question. If he makes that distinction, then he is in a field of metaphysics. In magic, he may be beyond that distinction. But once he gets to making it, then he is making metaphysics.

**Wilkins:**

Presumably, metaphysics could also encompass magic.

**Bohm:**

It could, but I'm saying that as first metaphysics is usually anti-magical. So therefore you have this

metaphysics, and we could say what is the role of metaphysics? There is certainly no way ever to prove it or disprove it, right? Neither logically nor — you know, it doesn't follow logic. It raises questions that are not logical. You can't from any finite number of experiences say anything about everything, right? Therefore, is there any role to metaphysics at all? See, as some philosophers have said we should get rid of it. But I'm saying no, there is a role, which is that we think of thought not as with its content. We say thought is part of the dance of the mind. Metaphysics is part of the attempt to achieve a certain harmony in that dance. Therefore, we have gone beyond the meaning. Say that the ultimate function or activity of metaphysics is helping to make the brain operate more harmoniously. If it's bad metaphysics, it will operate less harmoniously. Because metaphysics is not in correspondence with any facts that you could ever get. Nor is it tested by logic, ultimately.

**Wilkins:**

Do you need to bring the brain into it?

**Bohm:**

Yes, because the dance of the mind will affect the brain. Aristotelian metaphysics disorganizes the brain. I want to say, when it's extended too far. It helps create these violent enmities and so on, saying it's either this or that, and that's all there is to it. That means that we have confrontation.

**Wilkins:**

Yes, well, I could see that.

**Bohm:**

So I'm trying to say metaphysics is not nearly an ethereal subject. It actually tremendously affects the brain. Metaphysical questions affect the brain more than most others because what is true of everything has a powerful affect. Words like always, forever, never, and so on are terribly powerful. They're used in popular songs because of their power. But they are metaphysical notions.

**Wilkins:**

Yes, you mean all science is sort of metaphysical.

**Bohm:**

Yes. And that has powerful — See, metaphysics is what will surely be defended irrationally, if you're not conscious of it. On the other hand some people have said just scrub out all metaphysics, but you can't. Therefore, we have to say what is the right attitude to metaphysics. I say metaphysics is part of the process. It's the dance of the mind. In metaphysics the mind is creatively trying to achieve harmony, but when it gets stuck then it achieves disharmony.

**Wilkins:**

Who are the people who want to get rid of all —

**Bohm:**

Well, positivists.

**Wilkins:**

Were there any others apart from them?

**Bohm:**

I don't know. Positivism has been a very powerful trend in modern thought.

**Wilkins:**

[Inaudible] limited, isn't it?

**Bohm:**

Uh huh [yes].

**Wilkins:**

I was going to say that the rise of positivism is almost comparable with the rise of Nazism. It's quite extraordinary.

**Bohm:**

It has a very powerful effect on the mind making those assumptions. It affects the brain.

**Wilkins:**

I think that's very true, yes. This is the basis of so much of the impact of the science on people's general attitudes toward life.

**Bohm:**

Yes, and vice versa, the general attitudes work in science. This positivist attitude may have equally started outside of science and just people wanting to

be practical and get results and not be bothered with all these varied questions and so on.

**Wilkins:**

Sort of Philistine [?].

**Bohm:**

Yes. But anyway, I felt that I had come to some sort of consistent view of process, but I didn't fully develop it. I should have stated that this is a proposal; not a truth which I am stating. What I have said about all of this is a proposal also into harmony. But just to say I am not putting it as a final truth, but rather it's the best thing I can see for the time. And that might well be subject to change. We will never get a final — I can't see us getting a final solution to this question. The dialectical process will go on. Whatever we say, it will not be complete. And therefore it will go on to its opposite eventually. Any attempt to say something about everything will inevitably produce opposites.

**Wilkins:**

Okay, well then you could say that was the reason why dialectics led to it's exact opposite in the ???

## **Bohm:**

Yes, well it helped anyway. The positivists (and perhaps other people, I can't remember) said let's get out of this by not trying to say something about everything. But see, you can't get out of it that easily because they already by doing that, they have said something about everything. Which is to say that you must always avoid metaphysics. But that is metaphysics. Any statement with always is purely metaphysical. So you can't actually get out of the question —





